MONA OFFSHORE WIND PROJECT

Preliminary Environmental Information Report

Volume 1, chapter 3: Project description

Image of an offshore wind farm

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Final

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Glossary

Term	Meaning
Dynamic Positioning Vessel	A vessel which can control its movements automatically using propellers and thrusters in order to maintain a stationary position.
Geophysical surveys	Surveys of the seabed which collect data on seabed form and boulder mapping.
Geotechnical surveys	Surveys of the seabed which collect data on underlying seabed geology and rock layers.
High Voltage Alternating Current	Form of electricity that is used by the UK National Grid and is delivered to consumers.
Hydrodynamics	Physical processes of water movement e.g. ocean currents.
Maximum design scenario (MDS)	The MDS represents the parameters that make up the realistic worst case scenario. This is selected from a range of parameters and may be different for different receptors and activities.
Micrositing	The final selection of the position of infrastructure which may move in the order of a few metres to avoid an obstruction.
OSP topside	The topside of an offshore substation is the section that is located above the sea surface and houses the electrical equipment.
Project Design Envelope (PDE)	The PDE sets out the design assumptions and parameters from which the realistic MDSs are drawn for the Mona Offshore Wind Project EIA.
Unexploded Ordnance	Remains of explosive devices that did not detonate when they were deployed.

Acronyms

Acronym	Description
AfL	Agreement for Lease
BEIS	Business, Energy and Industrial Strategy
CAA	Civil Aviation Authority
CAP	Civil Aviation Publication
CBRA	Cable Burial Risk Assessment
CL:AIRE	Contaminated Land: Applications in Real Environments
CPT	Cone Penetration Testing
CTV	Crew Transfer Vessels
DCO	Development Consent Order
DGC	Defence Geographic Centre
DPV	Dynamic Positioning Vessel
ECoW	Ecological Clerk of Works
EIA	Environmental Impact Assessment

Acronym	Description
HAT	Highest Astronomical Tide
HDD	Horizontal Directional Drilling
HVAC	High Voltage Alternating Current
IALA	International Association of Marine Aids to Navigation and Lighthouse Authorities
ICPC	International Cable Protection Committee
IR	Infra-red
JB	Joint Bays
JUV	Jack-Up Vessel
LAT	Lowest Astronomical Tide
LB	Link Bays
LSS	Land Substation
MBES	Multi-Beam Echosounder
MCA	Maritime and Coastguard Agency
MDS	Maximum Design Scenario
MHWS	Mean High Water Springs
MLWS	Mean Low Water Springs
NEQ	Net Explosive Quantity
NPS	National Policy Statement
NRW	Natural Resources Wales
OFTO	Offshore Transmission Operator
OSP	Offshore Substation Platform
PDE	Project Design Envelope
PEIR	Preliminary Environmental Information Report
pUXO	Potential UXO
QSHE	Quality, Safety, Health and Environment
SAR	Search and Rescue
SBES	Single Beam Echosounder
SBP	Sub-Bottom Profiler
SSCS	Seabed Scour Control Systems
SOV	Service Operation Vessel
SPS	Significant Peripheral Structures
SWMP	Site Waste Management Plan
TCE	The Crown Estate

Acronym	Description
TJB	Transition Joint Bays
UKHO	UK Hydrographic Office
UXO	Unexploded Ordnance

Units

Unit	Description
cd	Candela
kJ	Kilojoules
kV	Kilovolts
km	Kilometres
km^2	Kilometres squared
m	Metres
m^3	Metres cubed
m^2	Metres squared
mm	Millimetres
nm	Nautical miles
%	Percentage
lb	Pound

3 Mona Offshore Wind Project Description

3.1 Introduction

3.1.1.1 Mona Offshore Wind Limited (the Applicant), a joint venture of bp Alternative Energy Investments Ltd (hereafter referred to as bp) and Energie Baden-Württemberg AG (hereafter referred to as EnBW) is developing the Mona Offshore Wind Project. This chapter of the Preliminary Environmental Information Report (PEIR) provides an outline description of the offshore and onshore components required for the construction, operation and maintenance and decommissioning phases of the Mona Offshore Wind Project, based on preliminary design information and the current understanding of the receiving environment.

3.1.1.2 The Applicant has, through the Environmental Impact Assessment (EIA) process (i.e. from Scoping to the PEIR), started to refine the proposed envelope and provide more detailed realistic Maximum Design Scenarios (MDSs) where available. These parameters will be further refined between the PEIR and the final Environmental Statement, taking into account responses from consultation. The refined parameters will be presented in the Environmental Statement and draft Development Consent Order (DCO). The final Mona Offshore Wind Project design will be selected after development consent has been granted, in line with the parameters stated in the project description within the Environmental Statement.

3.2 Project design status

3.2.1.1 The Project Design Envelope (PDE) approach (also known as the Rochdale Envelope approach) will be adopted for the EIA of the Mona Offshore Wind Project, in accordance with industry good practice. The PDE sets out the design assumptions and parameters from which the realistic MDSs are drawn for the Mona Offshore Wind Project EIA. Further information on the Rochdale Envelope approach is presented in volume 1, chapter 5: EIA Methodology of the PEIR.

3.2.1.2 The Mona Offshore Wind Project is in the early stages of the development process. Therefore, the project description is indicative and the 'envelope' has been designed to include flexibility to accommodate further project refinement during detailed design, post consent. Offshore wind is a continually evolving industry with a constant focus on cost reduction, therefore improvements in technology and construction methodologies occur frequently and an unnecessarily prescriptive approach could preclude the adoption of new technology and methods. Consequently, this chapter sets out a series of parameters.

3.2.1.3 This project description does not refer directly to the generation capacity of the wind turbines but rather their physical dimensions. Subsequently, the assessments are not linked directly to the wind turbine capacity (but rather their physical dimensions such as tip height and rotor diameter).

3.3 Mona Offshore Wind Project Boundary

3.3.1.1 The Mona Offshore Wind Project is presented in Figure 3.1 and consists of the following:

- Mona Array Area: This is where the wind turbines, foundations, inter-array cables, Offshore Substation Platforms (OSPs) as well as interconnector cables and offshore export cables will be located
- Mona Offshore Cable Corridor: The corridor located between the Mona Array Area and the landfall up to Mean High Water Springs (MHWS), in which the offshore export cables will be located
- Landfall: This is where the offshore export cables make contact with land and the transitional area where the offshore cabling connects to the onshore cabling
- Mona Proposed Onshore Development Area: The area landward of MHWS in which the landfall, onshore cable corridor, onshore substation, mitigation areas, temporary construction facilities (such as access roads and construction compounds), and the connection to National Grid infrastructure will be located
- Mona Onshore Substation: This is where the new substation will be located, containing the components for transforming the power supplied from the offshore wind farm up to 400kV
- Mona 400kV Grid Connection Cable: The corridor between the Mona Onshore Substation and existing National Grid substation at Bodelwyddan in which the onshore 400kV grid connection cables will be located.

3.4 Agreement for Lease area

3.4.1.1 The Applicant entered into Agreement for Lease (AfL) for the Mona Offshore Wind Project in January 2023. The AfL for the Mona Array Area covers approximately 500km^2 and is located in the east Irish Sea, 28.2km (15.2nm) from the Anglesey coastline, 39.9km (21.5nm) from the northwest coast of England, and 42.3km (22.8nm) from the Isle of Man (when measured from Mean High Water Springs (MHWS)). Subsequent to the identification of the AfL site, the Mona Offshore Wind Project has refined the AfL area down to the Mona Array Area, an area of approximately 449km^2 which is presented within the PEIR. The offshore infrastructure, such as the wind turbines, OSPs, interconnector cables and inter-array cables will be located within the Mona Array Area (Figure 3.1).

3.5 Consultation

3.5.1.1 Consultation is an important part of the EIA process and has been carried out to date with both statutory and non-statutory stakeholders through pre-scoping consultation and through the EIA Scoping Report. A summary of the key issues raised during consultation activities undertaken to date specific to the project description is presented in Table 3.1, together with how these issues have been considered in the design of the Mona Offshore Wind Project.

3.5.1.2 Consultation will continue throughout the pre-application phase of the Mona Offshore Wind Project. Wider consultation on the Mona Offshore Wind Project with stakeholders and local communities is described in volume 1, chapter 1: Introduction of the PEIR. Topic-specific consultation is presented in the relevant topic chapter of the PEIR.

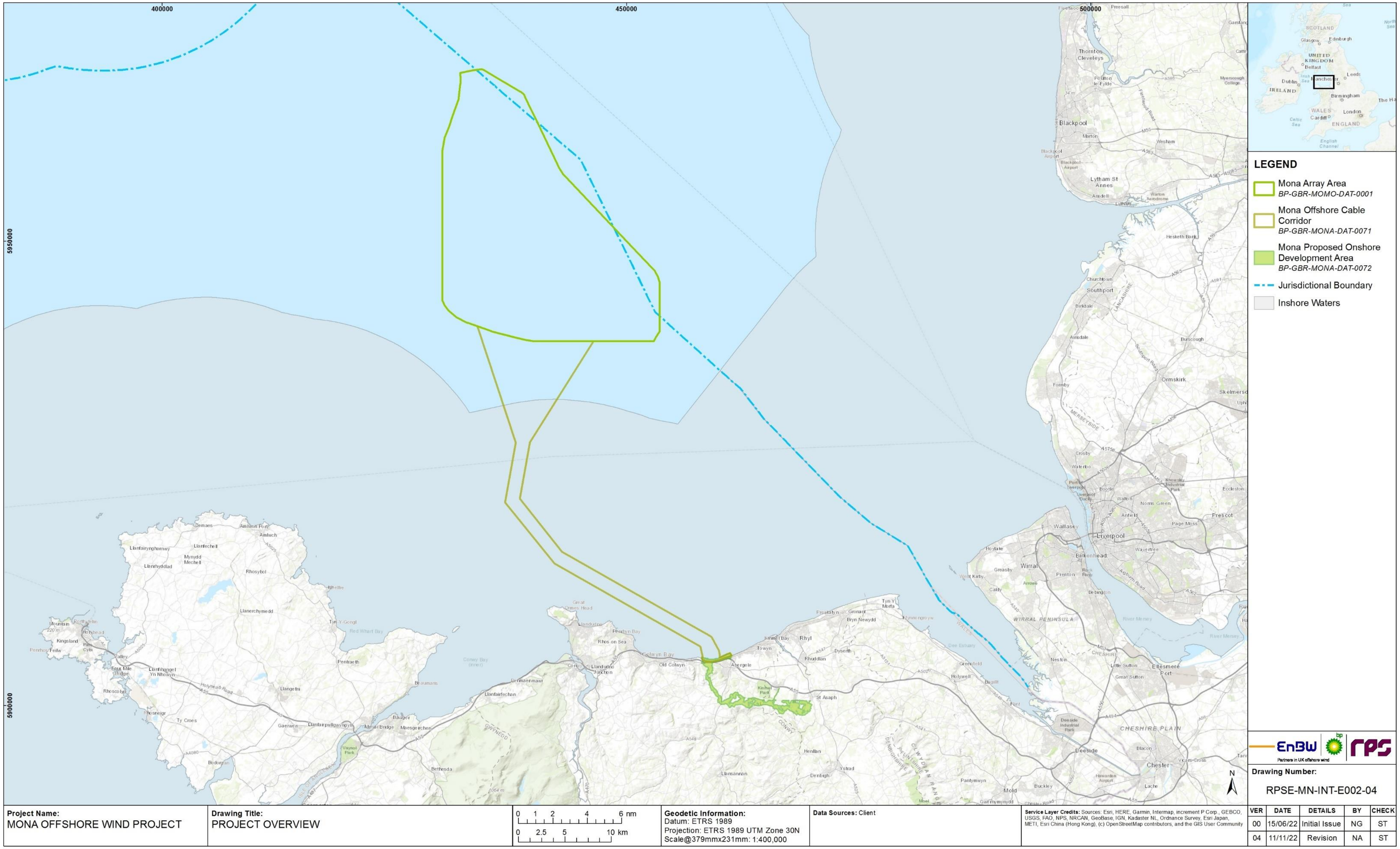

Figure 3.1: Overview of the Mona Offshore Wind Project location.

Table 3.1: Summary of key consultation issues raised during consultation activities undertaken for the Mona Offshore Wind Project relevant to the project design.

Date	Consultee and type of response	Issues raised	Response to issue raised and/or were considered in this chapter
June 2022	The Planning Inspectorate - Scoping Opinion	Request for clarification regarding how the realistic worst case scenario related to the MDS. The Environmental Statement should assess the worst case that could potentially be built out in accordance with the Authorised Development of the DCO being applied for.	A further description of the PDE approach has been provided in volume 1, chapter 5: EIA methodology chapter of the PEIR. The approach allows EIA to be conducted on the basis of a realistic 'worst case' scenario (i.e. the maximum project design parameters) which is selected from a range of design values. The term 'maximum design scenario' will be used throughout the PEIR and Environmental Statement. The worst case that could potentially be built out will be selected on a topic-by-topic and impact-by-impact basis and assessed.
June 2022	The Planning Inspectorate - Scoping Opinion	The Environmental Statement should identify the likely site for disposal of drill arisings and include an assessment of effects from these activities.	Drill arisings will be disposed of in the vicinity of the source. This is described in section 3.6.8 of volume 1, chapter 3: Project description of the PEIR and assessed in the relevant topic chapters.
June 2022	The Planning Inspectorate - Scoping Opinion	The Environmental Statement should provide further detail on the proposed pre-construction activities and seabed preparation activities.	The seabed preparation activities required is described in section 3.6.3 of volume 1, chapter 3: Project description of the PEIR. The assumptions around the number and type of Unexploded Ordnance (UXO) considered in the assessment is presented in section 3.6.3 of volume 1, chapter 3: Project description of the PEIR. Any likely significant effects have been assessed in the relevant topic chapters.
June 2022	The Planning Inspectorate - Scoping Opinion	The Environmental Statement should provide the footprint and volume of any scour and cable protection to be used.	The volume and footprint of scour and cable protection being considered is presented in section 3.6.8 and 3.6.9 of volume 1, chapter 3: Project description of the PEIR.
June 2022	The Planning Inspectorate - Scoping Opinion	The Environmental Statement should identify any temporary or permanent crossings of watercourses, major roads and/or railways.	The type of crossings being considered for watercourses, major roads and/or railways is presented in section 3.7.2 of volume 1, chapter 3: Project description of the PEIR. Locations of such crossings and the use of a specific method to mitigate significant effects Is presented in the relevant topic chapters.
June 2022	The Planning Inspectorate - Scoping Opinion	The location of the port and operations and maintenance base to be used should be identified and any potentially significant effects should be assessed.	A single port or multiple ports in north Wales and/or the northwest of England could be used to support primary elements of operations and maintenance.
June 2022	The Planning Inspectorate - Scoping Opinion	The Environmental Statement should detail any temporary or permanent lighting requirements and ensure that any likely significant effects from their presence are assessed within the Environmental Statement.	The offshore marking and lighting requirements are presented in section 3.6.10 of volume 1, chapter 3: Project description of the PEIR and assessed in the relevant topic chapters.
June 2022	The Planning Inspectorate - Scoping Opinion	The Environmental Statement should provide a full description of the nature and scope of operations and maintenance activities, including types of activity, frequency, and how works will be carried out for both offshore and onshore components.	A description of onshore and offshore operations and maintenance activities for which consent is sought under the DCO are presented in section 3.9 of volume 1, chapter 3: Project description of the PEIR.
June 2022	The Planning Inspectorate - Scoping Opinion	The Environmental Statement should detail the type, number and frequency of vessel movements required to construct and operate the Mona Offshore Wind Project.	The type of vessels to be used alongside the number of vessels and vessel round trips required is presented in section 3.6 of volume 1, chapter 3: Project description of the PEIR.
June 2022	The Planning Inspectorate - Scoping Opinion	The Environmental Statement should confirm the quantities of excavated material to be stockpiled and be consistent in its reporting.	Excavated material will be generated from the construction of the Mona Onshore Cable Corridor Search Area and will primarily be stored within the temporary working area. Other storage areas may also be located within the Mona Proposed Onshore Development Area. The construction of the Mona Onshore Substation will also require material to be excavated and will be stockpiled within the temporary working area. This information will be included in volume 1, chapter 3: Project description of the PEIR together with estimated quantities of material to be excavated (and stockpiled) from the Mona Onshore Cable Corridor Search Area based on the length and width of the onshore export cable and the 400kV Grid Connection Cables.
June 2022	The Planning Inspectorate - Scoping Opinion	The Environmental Statement should detail the number of anticipated full and part time jobs generated by all phases of the Mona Offshore Wind Project.	The Environmental Statement will include the number of full and part-time jobs generated from the construction and operation of the Mona Offshore Wind Project. This information will be presented in the Environmental Statement only.
June 2022	The Planning Inspectorate - Scoping Opinion	The Environmental Statement should confirm whether any permanent diversions or closures of Public Rights of Way (PRoW) would be required during the operations and maintenance phase.	Any permanent diversions or closures of PRoWs required during the operation of the Mona Offshore Wind Project will be identified and assessed within volume 3, chapter 20: Land use and recreation of the PEIR.

Project infrastructure overview

3.5.1.3 The Mona Offshore Wind Project will be located in the east Irish Sea, with a landfall on the North Wales coastline and a connection to the existing Bodelwyddan National Grid substation.

3.5.1.4 The Mona Offshore Wind Project will consist of up to 107 wind turbines. The capacity of the Mona Offshore Wind Project is over 350MW, therefore it is within the Planning Act 2008 thresholds for Welsh offshore schemes. The final capacity of the Mona Offshore Wind Project will be determined based on available technology and constrained by the design envelope of the wind turbines presented in this chapter. The offshore infrastructure will also include up to 360km of offshore export cables, 50km of interconnector cables and 500km of inter-array cables.

3.5.1.5 The onshore infrastructure will consist of up to 12 onshore export cables buried in up to four trenches and an onshore High Voltage Alternating Current (HVAC) substation to allow the power to be transferred to the National Grid via the existing Bodelwyddan National Grid substation.

3.5.1.6 The key components of the Mona Offshore Wind Project are shown in Figure 3.2 and the key parameters are presented in Table 3.2.

3.5.1.7 The Applicant intends to commence construction of the Mona Offshore Wind Project in 2026 and for it to be fully operational by 2030 in order to help meet UK and Welsh Government renewable energy targets.

Table 3.2: Key parameters for the Mona Offshore Wind Project.

Parameter	Value
Mona Array Area (km^2)	449.97
Average water depth (m LAT)	-39.23
Maximum number of wind turbines	107
Maximum blade tip height above LAT (m)	324
Maximum number of OSPs	4
Maximum number of offshore export cables	4
Maximum number of onshore export cables	12
Maximum length of inter-array cables (km)	500
Maximum length of interconnector cables (km)	50
Maximum length of offshore export cables (km)	360
Maximum length of onshore export cables (km)	18
Maximum length of 400kV grid connection cables (km)	3

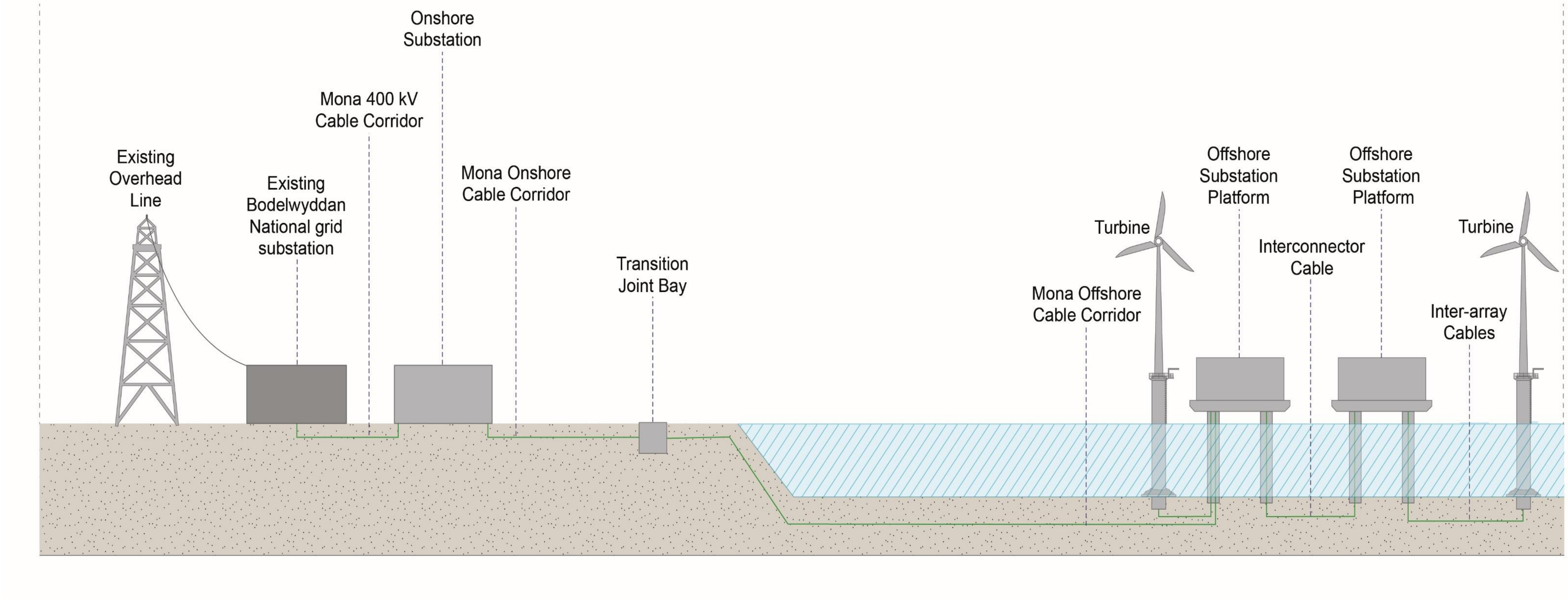

Figure 3.2: Overview of the Mona Offshore Wind Project infrastructure.

3.6 Offshore Infrastructure

3.6.1 Overview

3.6.1.1 This section describes the geophysical and geotechnical site investigation surveys as well as UXO clearance required to be undertaken before construction commences. Once these are completed, construction will commence with site preparation activities. Site preparation may include boulder clearance, sandwave clearance and seabed preparation activities. This section then goes on to describe the offshore infrastructure that will be constructed within the Mona Array Area and Mona Offshore Cable Corridor following the completion of the site preparation activities. The offshore infrastructure will include: wind turbines, OSPs, foundations, inter-array cables, interconnector cables, offshore export cables, and scour and cable protection. This section also describes the aids to navigation and safety practices that the Applicant will adopt.

3.6.2 Pre-construction site investigation surveys

3.6.2.1 Pre-construction site investigation surveys will be undertaken to provide detailed information on seabed conditions, morphology and to identify the presence/absence of any potential obstructions or hazards and to verify the seabed geology layers. Pre-construction site investigation surveys are likely to include geophysical and geotechnical surveys which will be conducted within, and in the vicinity of, the footprint of the Mona Offshore Cable Corridor and Mona Array Area. Geophysical survey works will be carried out to provide detailed UXO, bedform and boulder mapping, bathymetry, a topographical overview of the seabed and an indication of sub-layers. Geotechnical surveys will be conducted at specific locations within the Mona Offshore Cable Corridor and the Mona Array Area.

3.6.2.2 The geophysical site investigation is anticipated to include the following activities which are commonly undertaken as best practice for offshore wind farms. Frequencies and sound levels for sonar equipment has been included:

- Multi-Beam Echosounder (MBES) (200-500kHz; 180-240dB re 1 1μPa)
- Sidescan Sonar (SSS) (200-700kHz; 216-228dB re 1 1μPa)
- Single Beam Echosounder (SBES) (200-400kHz; 180-240dB re 1 1μPa)
- Sub-Bottom Profilers (SBP) (0.2-14kHz chirp, 2-7kHz pinger; 200-240 chirp dB re 1 1μPa, 200-235 pinger (both) dB re 1 1μPa)
- Ultra-High Resolution Seismic (UHRS) (0.05-4kHz; 170-200dB re 11μPa)
- Magnetometer.

3.6.2.3 The geotechnical site investigation is anticipated to include the following activities which are commonly undertaken as best practice for offshore wind farms:

- Boreholes
- Cone penetration tests (CPTs)
- Vibrocores.

3.6.3 Unexploded Ordnance clearance

3.6.3.1 It is possible that UXO may be encountered during the construction of offshore infrastructure. This poses a health and safety risk where it coincides with the planned location of infrastructure and associated vessel activity and therefore it is necessary to survey for, and manage, potential UXO. In order to identify UXO, detailed surveys of the location where infrastructure will be located are required. This work cannot be conducted before a consent application is submitted because the detailed design work needed to confirm the location of infrastructure is reliant upon the pre-construction site investigation surveys outlined in paragraph 3.6.2.1. In addition, the survey for identification of potential UXO (pUXO) must be undertaken within approximately one year ahead of the start of construction due to the potential for hydrodynamics to uncover UXO that may not be detected in pre-application surveys. The Applicant commissioned a study to establish the potential for UXO presence at the Mona Offshore Wind Project. Based on the results of this study and a conservative estimate, the design envelope for UXO clearance is described in Table 3.3. Furthermore, a range of UXO sizes is predicted with the Net Explosive Quantity (NEQ) ranging between 25kg to 907kg with 130kg being the most likely maximum.

Table 3.3: UXO across the Mona Array Area and Mona Offshore Cable Corridor.

Parameter	UXO
Potential UXO as constraints to operations	3,183
Potential UXO requiring inspection	310
Percentage Potential UXO to Confirmed UXO	7.5%
Total UXO predicted to require clearance	22

3.6.3.2 The Mona Offshore Wind Project will submit a clearance method statement, confirmation of UXO for clearance and confirmation that clearance does not coincide with archaeology/sensitive seabed features to the regulator pre-construction once UXO surveys are complete.

Methodology

3.6.3.3 UXO targets identified during the pre-construction site investigation surveys will be investigated to determine if they are UXO. If they are classified as a UXO, they can either be cleared or avoided. UXO may be avoided through micrositing of infrastructure, cleared through *in-situ* clearance or recovery of the UXO for disposal at an alternate location. The method of clearance will depend on factors such as the condition of the UXO and will be subject to the UXO clearance contractors' safety assessment.

3.6.3.4 There are a number of methodologies that may be used to clear UXO targets, including detonation of the UXO using an explosive counter-charge placed next to the UXO on the seabed (referred to as a 'high order' technique) or methods that neutralise the UXO to be safe without detonation (referred to as 'low order' techniques). These low order techniques include 'deflagration' which involves the use of a small charge to 'burn out' the explosive material without detonation.

3.6.3.5 The use of the low order techniques is dependent on the condition of the UXO and individual circumstances. Furthermore, the Applicant will not know what condition a UXO is in until it is investigated through the pre-construction site investigation surveys. Therefore, whilst the use of low-order techniques is a potentially viable solution for clearance of UXO, it is not possible to make a commitment to using them at this stage as it will not be known whether it is a feasible option.

3.6.4 Site preparation activities

Boulder clearance and out of service cables

3.6.4.1 Boulder clearance is commonly required during site preparation for installation of offshore wind farm infrastructure. Boulders would pose the risk of damage and exposure to cables as well as an obstruction risk to the cable installation equipment. Therefore, any boulders that would impact on installation will be required to be cleared from the Mona Offshore Cable Corridor and Mona Array Area.

3.6.4.2 The pre-application site-specific geophysical surveys have identified that boulder clearance may be required in the vicinity of the foundation locations, along the inter-array cables, interconnector cables and offshore export cables. Boulder clearance would occur within the footprint of other installation activities therefore the footprint is not presented to prevent double counting of the seabed footprint parameters.

3.6.4.3 If the final location of the Mona Offshore Wind Project infrastructure crosses any out of service cables, these will be removed. Any cable removal will be undertaken in consultation with the asset owner and in accordance with the International Cable Protection Committee (ICPC) guidelines (2011). Cables will be retrieved to a vessel deck, where one end will be cut, pulled the cable past the crossing point, and then cut again before being pulled to the surface where it will be removed from site by the vessel.

Sandwave clearance for cables, and sandwave clearance and/or seabed preparation for foundations

3.6.4.4 In some areas within the Mona Array Area and along the Mona Offshore Cable Corridor, existing sandwaves and similar bedforms may require to be removed before cables and foundations are installed. Many of the cable installation tools require a stable, flat seabed surface in order to perform as it may not be possible to install the cable up or down a slope over a certain angle. In addition, the cables must be buried to a depth where they can be expected to stay buried for the duration of the lifetime of the Mona Offshore Wind Project. Sandwaves are generally mobile in nature therefore cables must be buried beneath the level where natural sandwave movement could uncover them. Wind turbine foundations need to be placed in level, pre-prepared areas of seabed. This can only be achieved by removing the mobile sediments before installation takes place.

3.6.4.5 Site-specific geophysical data from the Mona Array Area and bathymetry data was used to identify sandwaves and it was determined that up to 50% of the inter-array, 60% of the interconnector and 70% of the offshore export cables would require sandwave clearance. Site-specific geophysical data from the Mona Array Area and bathymetry data identified that up to 50% of foundation locations may require sandwave clearance. UXO and boulder clearance will also be required. These activities are discussed earlier in this section. Additional seabed preparation may be required for gravity base foundations, including dredging of the soft sediments. If dredging is required, it would be carried out by dredging vessels using suction hoppers or similar.

3.6.4.6 The MDS for sandwave clearance and seabed preparation in the Mona Array Area is summarised in Table 3.4. The MDS for sandwave clearance and seabed preparation for foundations is based on the four-legged suction bucket foundation option (foundation options are further described in section 3.6.8). The MDS for sandwave clearance in the Mona Offshore Cable Corridor is summarised in Table 3.5. It should be noted that boulder clearance will occur over the same location as the sandwave clearance. The corridor width for boulder clearance is less than is required for sandwave clearance therefore boulder clearance represents repeat disturbance to the seabed.

3.6.4.7 It is expected that material subject to seabed preparation activities will be deposited in the vicinity of where they were removed. A dredging and disposal site characterisation for the disposal of seabed preparation material will be presented in a dredging and disposal site characterisation report as part of the Application for consent.

Table 3.4: Maximum design parameters for sandwave clearance and seabed preparation in the Mona Array Area.

Parameter	Maximum design parameters
Sandwave clearance impact width – inter-array and interconnector (m)	104
Sand-wave clearance: Inter-array cables (m^3)	9,542,806
Sand-wave clearance: Interconnector cables (m^3)	3,060,814
Sand-wave clearance and seabed preparation: Foundations (m^3)	8,416,621
Sand-wave clearance and seabed preparation: Total in Mona Array Area (inter-array cables, interconnector cables, foundations) (m^3)	21,020,241

Table 3.5: Maximum design parameters for sandwave clearance in the Mona Offshore Cable Corridor.

Parameter	Maximum design parameters
Sandwave clearance impact width (m)	104
Length of offshore export cables affected by sandwaves (m)	252,000
Sandwave clearance – total (m^3)	12,051,955

3.6.5 Wind turbines

Design

The Mona Offshore Wind Project will consist of up to 107 wind turbines, with the final number of wind turbines dependent on the capacity of the individual wind turbines used, and environmental and engineering survey results. Wind turbines with a range of generating capacities are being considered and are differentiated in the EIA as scenario 1 and 2 (Table 3.6). However, the physical parameters which form the basis of the MDS, such as maximum tip height or rotor diameter, will dictate the wind turbines that are ultimately installed, rather than these be limited by the maximum power ratings of individual turbines. The wind turbines will follow the traditional wind turbine design with a horizontal rotor axis with three blades connected to the nacelle of the wind turbine. The nacelle will be supported by a tower structure which is fixed to the transition piece and foundation. An illustration of this design can be seen in Figure 3.3 and a picture of an offshore wind turbine at the EnBW Hohe See Offshore Wind Farm is shown in Figure 3.4.

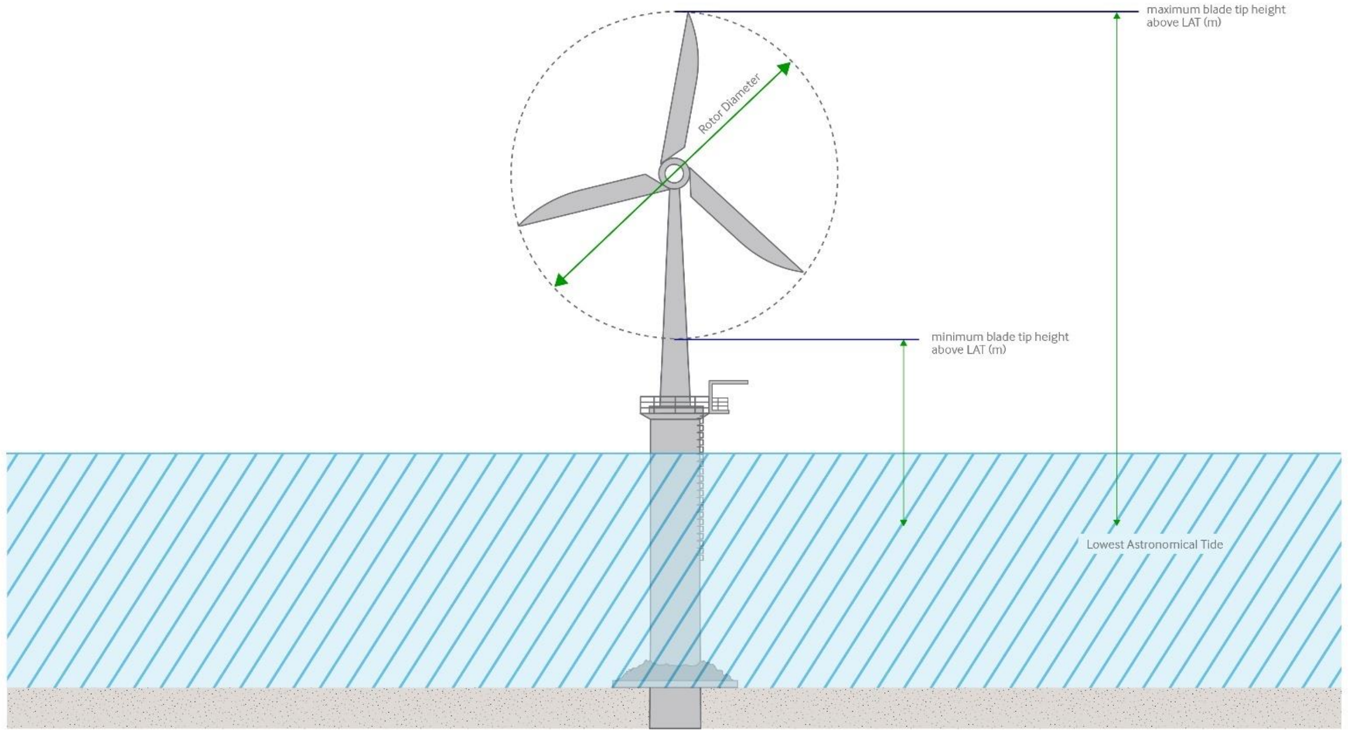

Figure 3.3: Schematic of an offshore wind turbine.

Figure 3.4: A picture of a wind turbine at the EnBW Hohe See Offshore wind farm in the German North Sea.

3.6.5.1 The MDS for wind turbines presented in Table 3.6 shows the scenarios being considered.

Table 3.6: Maximum design parameters: wind turbines.

Parameter	Scenario 1	Scenario 2
Number of turbines	107	68
Minimum height of lowest blade tip above Lowest Astronomical Tide (LAT) (m)	34	34
Maximum blade tip height above LAT (m)	293	324
Maximum rotor blade diameter (m)	250	280

Installation

3.6.5.2 Generally, wind turbines are installed using the following process:

1. Wind turbine components may be collected from a port in the UK, Europe or elsewhere and loaded onto barges or dedicated transport vessels at port and transported to the Mona Array Area. Generally, blades, nacelles, and towers for a number of wind turbines are loaded separately onto the vessel
2. Wind turbine components will be installed onto the existing foundations by an installation vessel. Each wind turbine will be assembled on site. The exact methodology for the assembly is dependent on the wind turbine type and installation contractor and will be defined in the pre-construction phase. Jack-Up Vessels (JUVs) are often used to ensure a stable platform for installation vessels when on site. JUVs are assumed to have up to six legs with an area of 350m^2 per foot.

3.6.5.3 The total duration for wind turbine installation is expected to be a maximum of 24 months.

3.6.5.4 Each installation vessel or barge may be assisted by a range of support vessels. These are typically smaller and may comprise of tugs, guard vessels, anchor handling vessels, or similar. These vessels will primarily shadow the same movements as the installation vessels they are supporting. For the purposes of the EIA, the assumptions in Table 3.7 have been made on the maximum number of installation and support vessels and the number of return trips to the Mona Array Area from port that are required throughout wind turbine installation. These numbers have been used to inform the assessment within volume 2: chapter 12 Shipping and navigation of the PEIR.

3.6.5.5 It is likely that the maximum number of installation vessels will be lower than those presented for PEIR. These changes will be presented and assessed within the Environmental Statement for the application for consent.

Table 3.7: Maximum design parameters for the wind turbines installation.

Vessel type	Maximum number of vessels on site at any one time	Maximum number of return trips per vessel type over the construction period
Installation and support vessels	4	76
Survey vessels	1	12
Crew Transfer Vessels (CTVs)	4	365
Helicopter support	2	365

3.6.6 Wind turbine and surface infrastructure layouts

3.6.6.1 The layout of the wind turbines will be developed to best utilise both the available wind resource and suitability of seabed conditions, while seeking to minimise environmental effects and impacts on other marine users (such as fisheries and shipping routes). The Mona Offshore Wind Project will be developed on the basis of the principles set out in Table 3.8.

3.6.6.2 In order to inform the EIA, the Applicant has identified indicative layout scenarios which are presented in the relevant topic-specific chapters of the PEIR. However, the final layout of the wind turbines will be confirmed at the final design phase post-consent.

Table 3.8: Layout development principles.

Principle	Definition
Principle 1	All wind turbines and OSPs will be located within the Mona Array Area. No blade overfly or structural overhang is permitted, therefore all wind turbines must be positioned at least half a rotor diameter inside the boundary of the Mona Array Area.
Principle 2	Minimum separation of 875m between wind turbines at the boundary of the wind farm and 1,000m within the wind farm.
Principle 3	Search and Rescue (SAR) lanes shall be allowed for and shall be a minimum of 500m wide, measured from the perimeter of any offshore asset. In the case of wind turbines, SAR lanes will be measured from the blade tips that are transverse to the wind turbine. SAR lanes will cross the Mona Array Area on the same bearing until the edge of the Mona Array Area or until a Helicopter Refuge Area is reached.
Principle 4	All assessments have considered at least one line of orientation. This will be reflected within the final wind turbine layout which will respect one line of orientation as a minimum. If the proposed final layout presents one line of orientation, a safety justification will be developed to demonstrate that risks to SAR and navigational safety are acceptable for such particular layout.
Principle 5	For all wind turbine positions, the tolerance allowance will be 100m, either side of the nominal wind turbine position whilst still complying with Principles 2 and 3.
Principle 6	For all wind turbine positions, the micrositing allowance will be 100m, either side of the target wind turbine position.

Principle	Definition
Principle 7	Packed boundaries are permitted, that is, wind turbines on the perimeter of the Mona Array Area maintain minimum spacing whilst internal spacing can be greater. The minimum wind turbine spacing shall be compliant with Principle 2 (minimum spacing of 875m). SAR lanes will be compliant with Principle 3 and access to the SAR lane will be allowed between the perimeter wind turbines.
Principle 8	Where SAR Access Lanes are more than circa 10nm, a Helicopter Refuge Area perpendicular to the SAR Access Lanes will be included within the layout design. The Helicopter Refuge Area shall be at least 1nm (tip to tip) in width and allow access across the Mona Array Area.

3.6.7 Offshore Substation Platforms

3.6.7.1 The OSPs will contain the equipment required to transform electricity generated at the wind turbines to a higher voltage for transportation onshore. They may also house auxiliary equipment and facilities for operating, maintaining and controlling the substation. They are likely to have one or more decks, a helicopter platform, cranes and communication antenna (Figure 3.5).

Figure 3.5: OSP at the EnBW Hohe See Offshore Wind Farm in the German North Sea.

3.6.7.2 Up to four separate OSPs will be required, and they will all be located within the Mona Array Area. The exact locations will be determined during the post-consent detailed design phase. Locations will take into account the ground conditions and the most efficient cable routing, amongst other considerations. They will follow the layout principles set out in Table 3.8. The OSPs are planned to be unmanned type A according to DNV-ST-0145 but once commissioned will be subject to regular operations and maintenance visits.

3.6.7.3 The maximum design parameters for the OSPs are presented in Table 3.9 and a schematic of an OSP is presented in Figure 3.6.

Table 3.9: Maximum design parameters for the OSPs.

Parameter	Maximum design parameters
Number of OSPs	4
Topside – main structure length (m)	80
Topside – main structure width (m)	60
Topside – height (excluding helideck or lightning protection) (LAT) (m)	70
Height of lightning protection and ancillary structures (LAT) (m)	95
Topside - area (m^2)	4,800

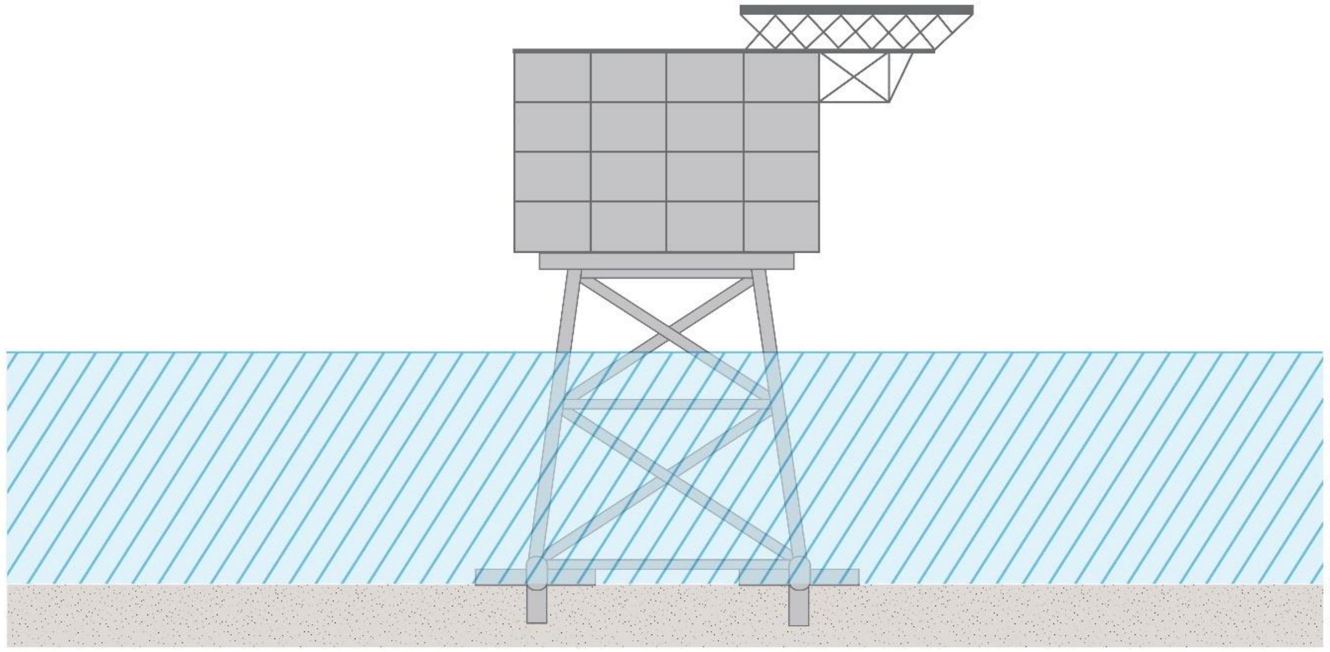

Figure 3.6: Schematic of an OSP.

Installation

3.6.7.4 OSPs are generally constructed by installing the foundation structure, then the topside will be lifted from a transport vessel/barge or floatover onto the foundation. The foundation and topside may be transported on the same transport vessel/barge, or separately. The vessel requirements for OSP installation are presented in Table 3.10.

Table 3.10: Maximum design parameters for the OSP installation.

Parameter	Maximum number of vessels on site at any one time	Maximum number of return trips per vessel type over the construction period
Primary installation and support vessels	9	45
Tug/anchor handlers	2	10
Survey vessels	1	3
Seabed preparation vessels	1	2
CTVs	2	40
Scour protection installation vessels	1	1
Helicopters	2	365

3.6.8 Foundations for wind turbines and OSPs

3.6.8.1 The wind turbines and OSPs will be attached to the seabed by foundation structures. The Applicant requires flexibility in foundation choice to ensure that anticipated changes in available technology can be accommodated within the Mona Offshore Wind Project final design. The foundation types that are being considered for the Mona Offshore Wind Project are shown in Table 3.11.

3.6.8.2 The foundations will be fabricated offsite, stored at a suitable port facility and transported to site by sea (see paragraph 3.6.5.2 *et seq*.). Specialist vessels transport and install foundations. Scour protection (typically rock) may be required on the seabed and will be installed before and/or after foundation installation (see paragraph 3.6.8.23 *et seq*.).

Table 3.11: Foundation options for wind turbines and OSPs.

	Wind turbines	OSPs
Maximum number of structures	107	4
Monopile	Yes	Yes
Pin piled three-legged Jacket	Yes	Yes
Pin piled four-legged Jacket	Yes	Yes
Pin piled six-legged Jacket	No	Yes
Suction bucket three-legged Jacket	Yes	Yes
Suction bucket four-legged Jacket	Yes	Yes
Suction bucket six-legged Jacket	No	Yes
Gravity base	Yes	Yes

Monopile foundations

Design

3.6.8.3 Monopile foundations typically consist of a single steel tubular piece. A transition piece is commonly fitted over the monopile and secured via bolts, grout or friction (slip joint). The transition piece may include ancillary components (e.g. boat landing facilities, ladders and a crane) as well as the connection to the wind turbine tower (Figure 3.7). The transition piece is generally painted yellow and marked per relevant regulatory guidance and may be installed separately following the monopile installation. The maximum design parameters of the monopile foundations can be seen in Table 3.12and Table 3.13.

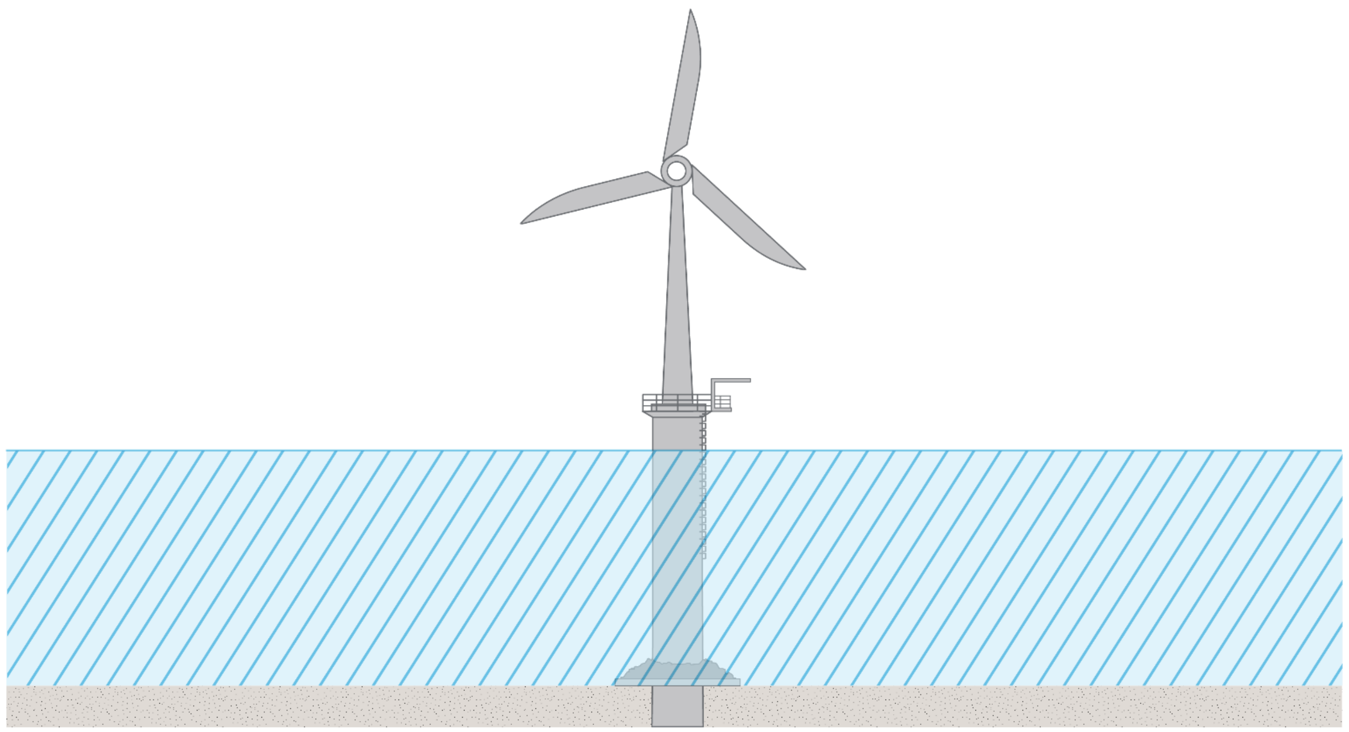

Figure 3.7: Schematic of an monopile foundation design.

Table 3.12: Maximum design parameters for monopile foundations - wind turbines.

[a] for the largest proposed wind turbine (noting that for the maximum number of turbines, the largest maximum design monopile diameter will be smaller).

Parameter	Maximum design parameters
Wind turbines	
Total number of structures (monopiles)	107
Diameter of a monopile (m)[a]	16
Diameter of transition piece (m)	12
Maximum embedment depth (below seabed) (m)	60
Hammer energy (kJ)	5,500
Seabed area –per monopile (m^2)	201.1

Parameter	Maximum design parameters
Seabed area – scour protection per monopile (m^2)	3,870
Seabed area – total foundation and scour protection for all foundations (m^2)	276,862
Scour protection volume – total for all foundations (m^3)	692,156
Total drill arisings for all foundations (m^3)	915,280

Table 3.13: Maximum design parameters for monopile foundations - OSPs.

Parameter	Maximum design parameters
Total number of structures	4
Number of monopiles per OSP	2
Diameter of a monopile (m)[a]	16
Diameter of transition piece (m)	12
Maximum embedment depth (below seabed) (m)	60
Hammer energy (kJ)	5,500
Seabed area –per monopile foundation (m^2)	201.1
Seabed area – scour protection per monopile (m^2)	7,741
Seabed area – total foundations and scour protection for all foundations (m^2)	9,161
Scour protection volume – total for all foundations (m^3)	20,358
Total drill arisings for all foundations (m^3)	27,315

Installation

3.6.8.4 Monopiles and transition pieces are likely to be transported to site either on the installation vessel (either JUV, Dynamic Positioning Vessel (DPV) or heavy lift vessel), as described in section 3.6.5. The details for the vessels and numbers of trips required are presented in Table 3.14. Monopile installation may take up to 24 months in total.

3.6.8.5 Seabed preparations for monopile installation are usually minimal. If pre-construction site investigation surveys show the presence of boulders or other seabed obstructions at the foundation locations, these may be removed if the foundation cannot be microsited to avoid the obstruction. Site preparation activities are discussed in more detail in section 3.6.3.

Table 3.14: Vessel and helicopter requirements for gravity base, monopile, piled jackets and suction bucket jacket foundation installation.

Vessel type	Maximum number of vessels on site at any one time	Maximum number of return trips per vessel type over the construction period
Installation and support vessels	9	400
Tug/anchor handler	6	64
Guard vessels	1	50
Survey vessels	2	12
Seabed preparation vessels	2	12
CTVs	4	365
Scour protection installation vessels	2	40
Helicopters	3	365

Piling and drilling

3.6.8.6 Monopiles are driven and/or drilled into the seabed, relying on the frictional and end bearing properties of the seabed for support. Up to two vessels may be piling or drilling simultaneously.

3.6.8.7 The modelled piling scenario (see volume 5, annex 3.1: Underwater sound technical report of the PEIR) for monopiles and pin piles assumes a maximum 9.5 hour duration. However it is expected that piling of monopiles will generally take significantly shorter time than 9.5 hours. Therefore, it is not expected that there will be an uninterrupted 9.5 hour start-finish hammer strike piling duration.

3.6.8.8 The maximum hammer energy for the Mona Offshore Wind Project is 5,500kJ for monopiles. Although a maximum hammer energy of 5,500kJ is considered as the MDS, the actual energy used when piling is likely to be significantly lower for the majority of the time. The hammer energy will only be raised to 5,500kJ when absolutely necessary. Hammer energies will start at the minimum required (10% soft start of 550kJ) and gradually increase to the maximum required energy required to install the pile, which is typically less than the maximum consented hammer energy.

3.6.8.9 If installation of the monopile is not possible through pile driving, a borehole will be drilled within the monopile using a drill bit with underreamer. Alternatively, a separate casing with a slightly bigger diameter than the monopile will be installed following the drill bit during lowering. In the latter case, the borehole will be grouted to seabed level when the monopile is installed and the casing be removed in parallel to the grouting operation. If drilling is required, spoil arising from the drilling will be disposed of within the local vicinity.

Piled jacket foundations

Design

3.6.8.10 Piled jacket foundations are formed of a steel lattice construction which is secured to the seabed by driven and/or drilled pin piles attached to the jacket feet. The transition piece and foundation structure are fabricated as an integrated part of the jacket. The Mona Offshore Wind Project may use either six-legged, four-legged or three-legged piled jacket foundations. An example of a pin piled jacket is shown in Figure 3.8.

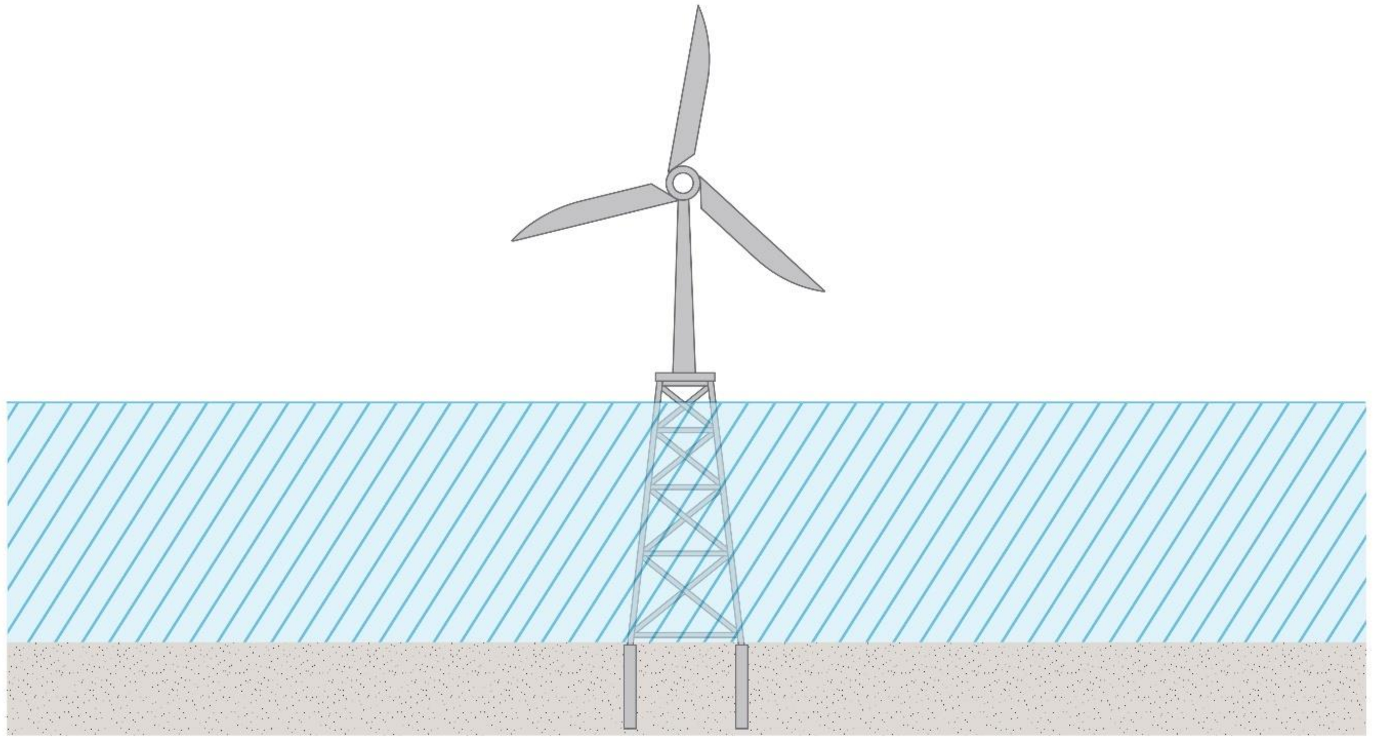

Figure 3.8: Schematic of a pin pile jacket foundation.

3.6.8.11 The maximum design parameters for jacket foundations with pin piles are shown in Table 3.15 and Table 3.16.

Table 3.15: Maximum design parameters for jacket foundations with pin piles - wind turbines.

Parameter	Maximum design parameter
Maximum number of jacket foundations	107
Number of legs per foundation	4
Piles per leg	2
Separation of adjacent legs at seabed level (m)	50
Separation of adjacent legs at LAT (m)	40
Leg diameter (m)	5
Pin pile diameter (m)	5.5
Maximum Embedment depth (below seabed) (m)	75
Hammer energy (kJ)	2,800
Seabed area – per foundation (m²)	170
Seabed area – scour protection per foundation (m²)	6,188
Seabed area – total foundations and scour protection for all foundations(m²)	432,316
Scour protection volume for all foundations (m³)	1,051,908
Total drill arisings for all foundations (m³)	859,656

Table 3.16: Maximum design parameters for jacket foundations with pin piles - OSPs.

Parameter	Maximum design parameter
Maximum number of jacket foundations	4
Number of legs per foundation	6
Piles per leg	3
Separation of adjacent legs at seabed level (m)	70
Separation of adjacent legs at LAT (m)	50
Leg diameter (m)	5
Pin pile diameter (m)	5.5
Maximum Embedment depth (below seabed) (m)	75
Hammer energy (kJ)	2,800
Seabed area – per foundation (m²)	428
Seabed area – scour protection per foundation (m²)	8,406
Seabed area – total foundations and scour protection for all foundations (m²)	10,745
Scour protection volume for all foundations (m³)	25,731
Total drill arisings for all foundations (m³)	37,926

Installation

3.6.8.12 The pin piles are driven and/or drilled into the seabed, in a similar way to monopiles. However, as pin piles are generally smaller than monopiles, the maximum hammer energy would be 2,800kJ. Up to two vessels may be piling and two drilling simultaneously. The maximum duration for wind turbine foundation installation across the Mona Array Area would be 24 months.

3.6.8.13 The pin piles may be installed before or after the jacket is installed on the seabed. If they are installed first, a piling template is positioned onto the seabed to guide the pin-piles to the required locations. The piles are then installed through the template, which is recovered to the installation vessel. If the pin piles are installed after the jacket has been placed on the seabed then a piling template is not required. The transition piece may include ancillary components (e.g. boat landing facilities, ladders and a crane) as well as the connection to the wind turbine tower.

3.6.8.14 The vessel movements for the installation would be as for monopile foundations, as described in Table 3.14.

3.6.8.15 The seabed preparation is described in section 3.6.3, the maximum design parameters for which are presented in Table 3.4.

Suction bucket jacket foundations

Design

3.6.8.16 Suction bucket jacket foundations are formed with a steel lattice construction fixed to the seabed by suction buckets installed below each leg of the jacket. The suction buckets are typically hollow steel cylinders, capped at the upper end, which are fitted underneath the legs of the jacket structure. They do not require a hammer or drill for installation. The transition piece and foundation structure are fabricated as an integrated part of the jacket structure and is not installed separately offshore. An example of a suction bucket jacket is shown in Figure 3.9. The maximum design parameters for jacket foundations with suction buckets are presented in Table 3.17.

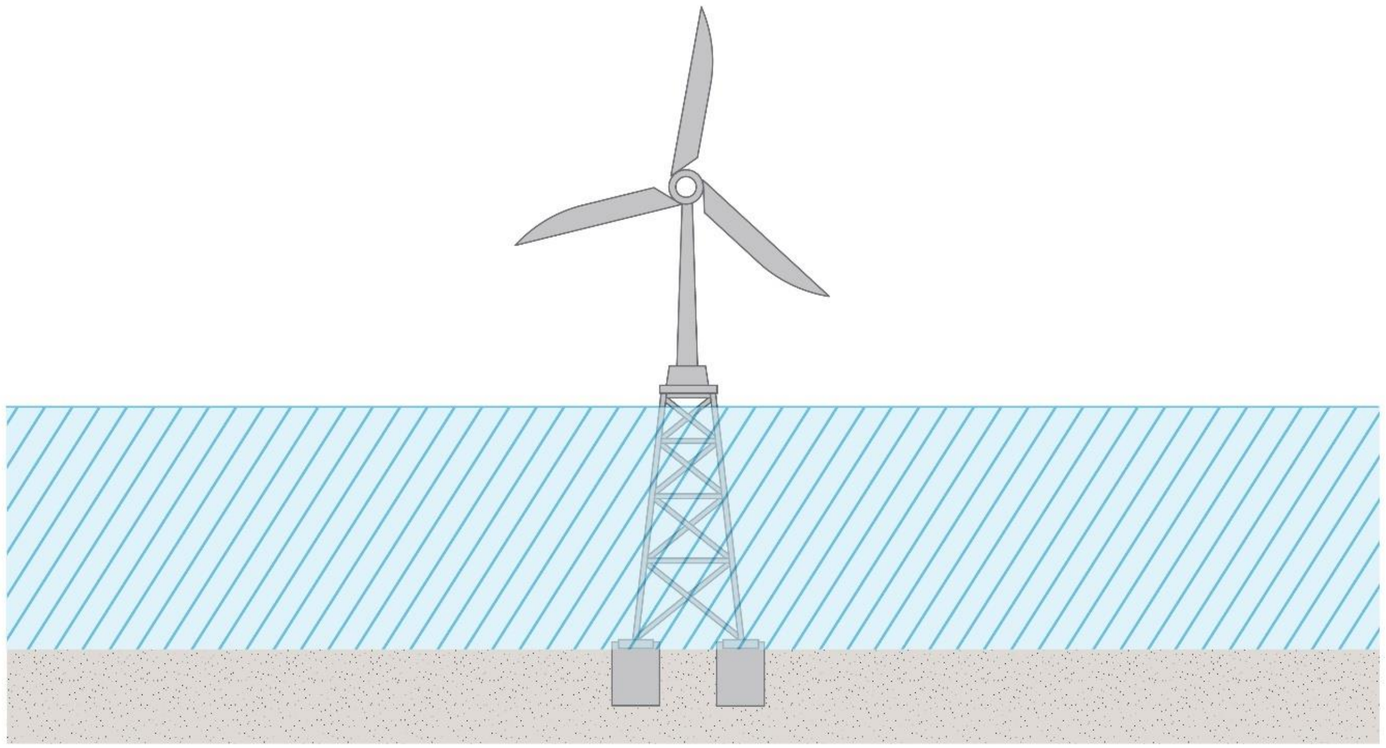

Figure 3.9: Schematic of a suction bucket jacket foundation.

Installation

3.6.8.17 The suction bucket jacket will be transported to site by sea, as described in section 3.6.5. The jacket foundation will then be lifted by the installation vessel using a crane and lowered towards the seabed in a controlled manner. When the steel buckets reach the seabed, a pipe above each bucket will begin to suck water out of each bucket. The buckets are pressed down into the seabed by the resulting suction force. When the bucket has penetrated the seabed to the desired depth, the pump is turned off. A thin layer of grout is then injected under the bucket to fill the air gap and ensure contact between the soil within the bucket, and the top of the bucket itself.

3.6.8.18 The seabed preparation is described in section 3.6.3. The vessel movements for the installation would be as for the monopile foundations, as described in Table 3.14.

Table 3.17: Maximum design parameters for jacket foundations with suction buckets - wind turbines.

Parameter	Maximum design parameter
Maximum number of jacket foundations	107
Number of legs per foundation	4
Suction bucket diameter (m)	18
Suction bucket depth (m)	25
Separation of adjacent legs at seabed level (m)	50
Separation of adjacent legs at LAT (m)	35
Seabed area per foundation (m^2)	804
Seabed area – scour protection per foundation (m^2)	10,012
Seabed area – total foundations and scour protection for all foundations (m^2)	735,488
Scour protection volume for all foundations (m^3)	1,701,998

Table 3.18: Maximum design parameters for jacket foundations with suction buckets - OSPs.

Parameter	Maximum design parameter
Maximum number of jacket foundations	4
Number of legs per foundation	6
Suction bucket diameter (m)	18
Suction bucket depth (m)	25
Separation of adjacent legs at seabed level (m)	70
Separation of adjacent legs at LAT (m)	50
Seabed area - per foundation (m^2)	1,527
Seabed area – scour protection per foundation (m^2)	13,502

Parameter	Maximum design parameter
Seabed area – total for all foundations (m²)	24,964
Scour protection volume for all foundations (m³)	56,252

Gravity base foundations

Design

3.6.8.19 Gravity base foundations are generally made of concrete with steel reinforcements, or steel alone, and consist of a base, a conical structure and a smaller cylindrical top (generally called the shaft). This shape provides support and stability to the wind turbine or OSP. Gravity base foundations could also include skirts that embed into the seabed under the weight of the structure to improve the natural stability and scour resistance of the foundation. Ancillary structures (e.g. ladders) may be attached to the gravity base foundation or the transition piece, and are usually made of steel but may be made of another metal. The main structure is filled with ballast, commonly sand, rock (such as olivine) or iron ore. An example of a gravity base foundation is shown in Figure 3.10.

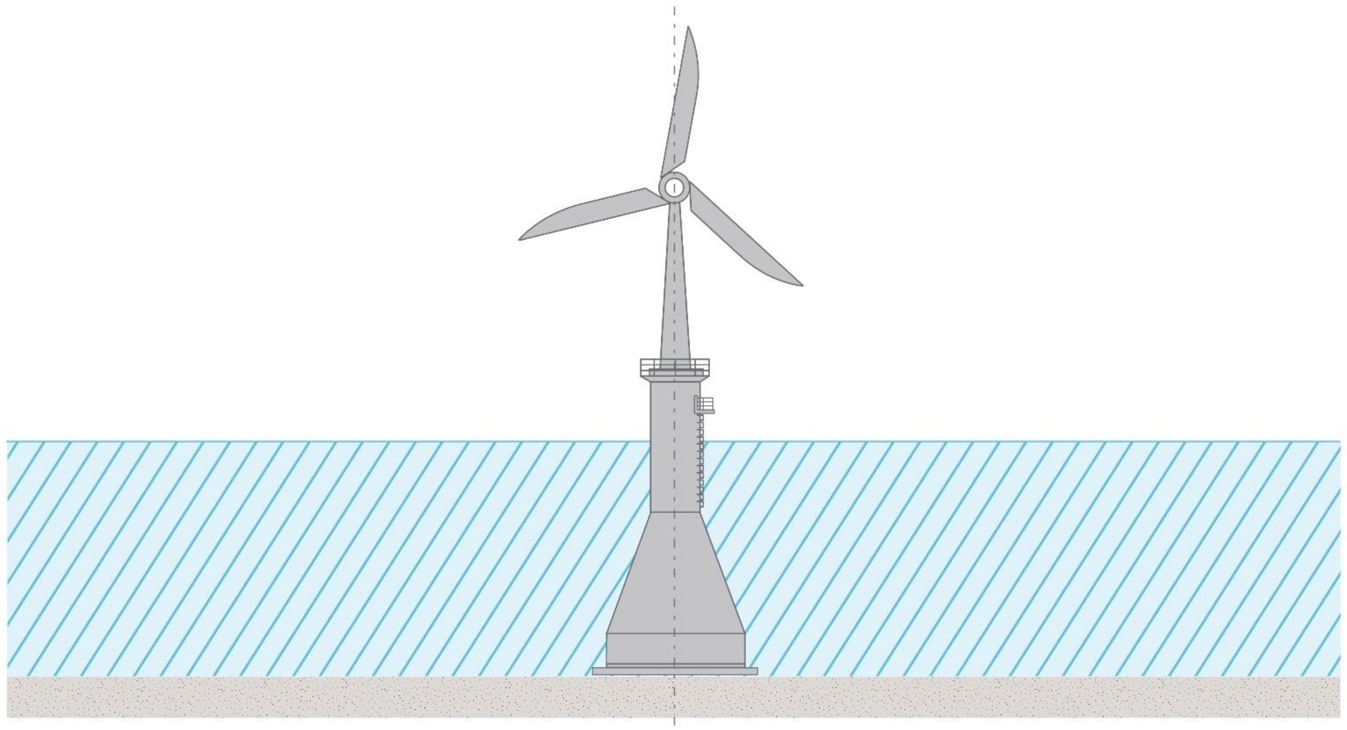

Figure 3.10: Schematic of a gravity base foundation.

3.6.8.20 The maximum design parameters for gravity base foundations for wind turbines are shown in Table 3.19, with the maximum design parameters for gravity base foundations for OSPs shown in Table 3.20.

Table 3.19: Maximum design parameters for gravity base foundations – wind turbines.

Parameter	Maximum design parameters
Total number of structures (gravity base)	107
Structural diameter at sea surface (m)	15
Structural diameter at seabed (base slab) (m)	56
Caisson diameter (m)	44
Transition Piece diameter (m)	15
Seabed area – per structure per foundation (m²)	2,463
Seabed area – scour protection per foundation (m²)	4,896
Seabed area – total foundations and scour protection for all foundations (m²)	650,787
Total scour protection volume for all foundations (m³)	1,522,842

Table 3.20: Maximum design parameters for gravity base foundations – OSPs.

Parameter	Maximum design parameters
Total number of structures (gravity base)	4
Structural diameter at sea surface (m)	20
Structural diameter at seabed (base slab) (m)	80
Caisson diameter (m)	70
Transition Piece diameter (m)	20
Seabed area – per structure per foundation (m²)	5,027
Seabed area – scour protection per foundation (m²)	13,600
Seabed area – total foundations and scour protection for all foundations (m²)	24,941
Total scour protection volume for all foundations (m³)	58,361

Installation

3.6.8.21 Gravity base foundations can be either transported by a vessel or barge to site or self-floated being pulled by tugs. Lowering at location will be conducted by flushing the gravity base foundation with seawater, assisted by a suitable crane from a heavy lift vessel to the seabed. Seabed preparation might be necessary in terms of levelling and/or stabilising the upper soil layer, this is described in section 3.6.3. After the gravity base foundation is installed, it will be ballasted with a suitable material before finally the transition piece will be installed on top, if applicable. The method to be used is dependent on the final gravity base design and the installation method would be confirmed following final design post-consent. The transition piece that is lifted on top of the gravity base may be either installed on site or installed prior to the transportation of the gravity base foundation.

3.6.8.22 The seabed preparation is described in section 3.6.3. The vessel movements for the installation would be as for monopile foundations, as described in Table 3.14.

Scour protection for foundations

3.6.8.23 Foundation structures for wind turbines and OSPs are at risk of seabed erosion and 'scour hole' formation due to natural hydrodynamic and sedimentary processes. The shape of the foundation structure is an important parameter influencing the potential depth of scour hole formation. Scour protection may be employed to mitigate scour around foundations. Several types of scour protection are under consideration, they are described below and presented in Figure 3.11:

- Rock: either layers of graded stones placed on and/or around structures to inhibit erosion or rock filled mesh fibre bags which adopt the shape of the seabed/structure as they are lowered on to it
- Concrete mattresses: several metres wide and long, cast of articulated concrete blocks which are linked by a polypropylene rope lattice which are placed on and/or around structures to stabilise the seabed and inhibit erosion
- Artificial fronds mattresses: mats typically several metres wide and long, composed of continuous lines of overlapping buoyant polypropylene fronds that create a drag barrier which prevents sediment in their vicinity being transported away. The frond lines are secured to a polyester webbing mesh base that is itself secured to the seabed by a weighted perimeter or anchors pre-attached to the mesh base.

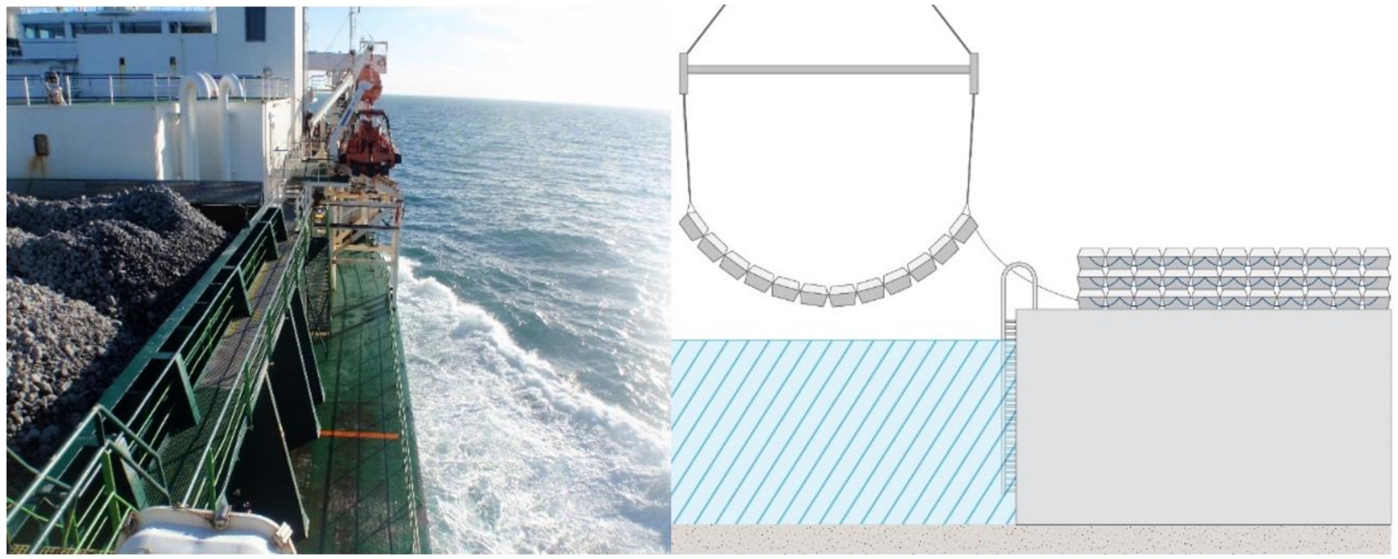

Figure 3.11: Illustrative scour protection types (Left: delivery of rock to EnBW's Hohe See offshore wind farm; Right: concrete mattresses).

3.6.8.24 The amount of scour protection required will vary for the different foundation types being considered for the Mona Offshore Wind Project. Scour protection parameters for the different foundations being considered are presented Table 3.12, Table 3.15, Table 3.17 and Table 3.19.

3.6.8.25 The final choice and detailed design of the scour protection will be made after detailed design of the foundation structure, taking into account a range of aspects including geotechnical data, meteorological and oceanographic data, water depth, foundation type and maintenance strategy.

3.6.9 Inter-array cables

3.6.9.1 Inter-array cables carry the electrical current produced by the wind turbines to an OSP. A small number of wind turbines will typically be grouped together on the same cable 'string' connecting those wind turbines to the OSP, and multiple cable 'strings' will connect back to each OSP.

Design

3.6.9.2 The maximum design parameters for inter-array cables are presented in Table 3.21.

Table 3.21: Maximum design parameters for inter-array cables.

Parameter	Maximum design parameters
Cable diameter (mm)	230
Total length of cable (km)	500
Voltage (kV)	132

Installation

3.6.9.3 The inter-array cables will be buried below the seabed wherever possible and protected with a hard-protective layer (such as rock or concrete mattresses) where adequate burial is not achievable. Possible installation methods include ploughing, trenching and jetting whereby the seabed is opened and the cable laid within the trench. Pre-trenching or post-lay burial methods may be used, alternatively simultaneous lay and burial using a tool towed behind the installation vessel. The installation method will be defined post consent based on a Cable Burial Risk Assessment (CBRA) (or similar) taking into account environmental and human conditions such as trawling and vessel anchors. Figure 3.12 shows an example of inter-array installation.

3.6.9.4 The Applicant may also need to undertake seabed preparation within the Mona Array Area prior to installation of inter-array cables in order to level sandwaves. This is discussed in section 3.6.3.

3.6.9.5 Inter-array cables will need to be protected where the route crosses obstacles such as exposed bedrock, pre-existing cables or pipelines that mean the cable cannot be buried. Cable protection methods include rock placement (rock protection), concrete mattresses, fronded mattresses and rock bags. Up to 10% of the total inter-array cable length may require protection due to ground conditions (this excludes cable protection due to cable crossings). The maximum design parameters for inter-array cable installation are presented in Table 3.22. The cable protection methods being considered are described below.

Figure 3.12: Example of inter-array cable installation at the EnBW Hohe See Offshore Wind Farm construction site in the German North Sea.

Table 3.22: Maximum design parameters for inter-array cable installation-cable protection.

[a] Typically the cable will be buried between 0.5 to 3m. A CBRA will inform cable burial depth, dependent on ground conditions as well as external risks. This assessment will be undertaken post-consent.

Parameter	Maximum design parameters
Installation methodology	Prelay plough, plough, trenching and jetting
Target burial depth	1m. Dependent on CBRA [a]
Width of seabed affected by installation per cable (m)	20
Duration: total (months)	36
Seabed disturbance – total for installation (m^2)	10,000,000
Height of cable protection (m)	3
Width of cable protection (m)	10
Percentage of route requiring protection (%)	10
Cable protection area (m^2)	500,000
Cable protection volume (m^3)	750,000
Indicative number of crossings	67
Cable/pipe crossings: total impacted area (m^2)	128,640
Cable/pipe crossings: cable protection volume (m^3)	80,400

Rock placements

3.6.9.6 Initially small stones are placed over the cable as a covering layer. This provides protection from any impact from larger size rocks, which may then be placed on top of this smaller scale level. Rock placement is often achieved using a vessel with equipment such as a 'fall pipe' which allows installation of rock close to the seabed. The length of the rock protection is dependent on the length of cable which is either unburied or has not achieved target depth.

Mattress placements

3.6.9.7 Concrete mattresses are constructed using high strength concrete blocks and U.V. stabilised polypropylene rope. Mattresses provide protection from direct anchor strikes but are not able to protect from anchor drag. The mattresses are lowered to the seabed from an installation vessel and once the correct position is confirmed, a frame release mechanism is triggered and the mattress is deployed on the seabed. This single mattress installation is repeated for the length of cable that requires protection. The mattresses may be gradually layered in a stepped formation on top of each other dependant on expected scour. Mattresses with sloped edges would be deployed to reduce the potential for fishing gear to snag the edges of the mattresses.

Frond mattresses placements

3.6.9.8 Mats typically several metres wide and long, composed of continuous lines of overlapping buoyant polypropylene fronds that create a drag barrier which prevents sediment in their vicinity being transported away. The frond lines are secured to a polyester webbing mesh base that is itself secured to the seabed by a weighted perimeter or anchors pre-attached to the mesh base. Frond mattresses are installed following the same procedure as general mattress placement operations. The fronds floating in the water column, however, can impede the correct placement of additional mattresses. The fronds are designed with the aim to catch and trap sediment to form protective, localised sand berms. Seabed Scour Control Systems (SSCS) Frond Mats installed in the North Sea in 1984 remain in place today and have required no maintenance since being deployed, as the mats are designed not to degrade with time (SSCS, 2022).

Rock bags

3.6.9.9 Prefilled rock bags consist of various sized rocks constrained within a rope or wire netting containment and can be placed above the cables with specialist installation beams. Rock bags are more suited for cable stability or trench/scour-related solutions. The number of rock bags required is dependent on the length of cable which requires protection.

3.6.9.10 Table 3.22 shows the details for the cable protection required for inter-array cables and Table 3.23 shows the envelope for vessel movements associated with inter-array cable installation.

Table 3.23: Maximum design parameters for inter-array cable installation vessel requirements.

Parameter	Maximum number of vessels on site at any one time	Maximum number of return trips per vessel type over the construction period
Cable lay and support vessels	4	8
Survey vessels	1	2
Seabed preparation vessels	4	4
CTVs	1	365
Cable protection installation vessels	2	2

3.6.10 Aids to navigation, colour, marking and lighting

3.6.10.1 The Mona Offshore Wind Project will be designed and constructed in accordance with relevant guidance from:

- Trinity House (2016) (Provision and Maintenance of Local Aids to Navigation Marking Offshore Renewable Energy Installations)
- Civil Aviation Authority (CAA) (2016) Civil Aviation Publication (CAP) 764 Policy and Guidelines on Wind Turbines
- Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) (2021) (Recommendation G1162 on the Marking of Man-Made Offshore Structures)
- Maritime and Coastguard Agency (MCA) (2018) (Offshore Renewable Energy Installations: Requirements, Guidance and Operational Considerations for Search and Rescue and Emergency Response).

3.6.10.2 Appropriate marking, lighting and aids to navigation will be employed during the construction, operations and maintenance, and decommissioning phases as appropriate to ensure the safety of all parties.

3.6.10.3 Appropriate lighting, in line with MCA (2018) guidance, will ensure the offshore structures are visible for search and rescue and emergency response procedures. In addition, Mona Offshore Wind Project lighting will conform to the following:

- Red, medium intensity aviation warning lights (of variable brightness between a maximum of 2000 candela (cd)) to a minimum of 10% of the maximum which would be 200cd) will be located on either side of the nacelle of significant peripheral wind turbines. These lights will flash simultaneously with a Morse W flash pattern and will also include an infra-red component
- All aviation warning lights will flash synchronously throughout the Mona Array Area and be able to be switched on and off by means of twilight switches (which activate when ambient light falls below a pre-set level)
- Aviation warning lights will allow for reduction in lighting intensity at and below the horizon when visibility from every wind turbine is more than 5km (to a minimum of 10% of the maximum (i.e. 200cd)
- SAR lighting of each of the non-periphery turbines will be combi infra-red (IR)/200cd steady red aviation hazard lights, individually switchable from the control centre at the request of the MCA (i.e. when conducting SAR operations in or around the Mona Array Area)
- All wind turbines will be fitted with a low intensity light for the purpose of helicopter winching (green hoist lamp). All wind turbines will also be fitted with suitable illumination (minimum one 5cd light) for ID signs
- Marine navigational lights will be fitted at the platform level on Significant Peripheral Structures (SPS). These lights will be synchronized to display simultaneously an IALA “special mark” characteristic, flashing yellow, with a range of not less than 5nm.

3.6.10.4 The location of all infrastructure (including wind turbines, OSPs, and cables) will be communicated to the UK Hydrographic Office (UKHO) so that they can be incorporated into Admiralty Charts and the Notice to Mariners procedures. These locations will also be provided to the Defence Geographic Centre (DGC).

3.6.10.5 A marking and lighting plan will be submitted to the MCA and Trinity House for review prior to construction.

3.6.11 Safety zones

3.6.11.1 During construction and decommissioning, some restrictions on vessel movements within the Mona Array Area and Mona Offshore Cable Corridor will be required to protect the health and safety of all users of the sea. The Applicant will apply for a 500m safety zone around all infrastructure that is actively under construction, including at the Mona intertidal area. Safety zones of 50m will be applied for vessels not associated with the Mona Offshore Wind Project around incomplete structures for which construction activity may be temporarily paused (and therefore the 500m safety zone is no longer applicable) such as installed foundations without wind turbines or where construction works are completed but the Mona Offshore Wind Project has not yet been commissioned.

3.6.11.2 During the operations and maintenance phase, the Applicant may apply for a 500m safety zone for infrastructure undergoing major maintenance works (for example a blade replacement). Further information regarding the Safety Zones which the Applicant intends to apply for post consent will be outlined in the Safety Zone Statement (to be provided with the application for consent).

3.6.11.3 Guard vessels will be used during the construction and the operations and maintenance phases of the Mona Offshore Wind Project as necessary.

3.6.12 Ancillary works

3.6.12.1 Ancillary works are likely to form part of the final design of the Mona Offshore Wind Project, however, the requirement and nature of these would be determined at the detailed design phase. Ancillary works may include:

- Temporary landing places, moorings or other means of accommodating vessels in the construction and/or maintenance of the Mona Offshore Wind Project

- Buoys, beacons, fenders and other navigational warning or ship impact protection works

3.6.12.2 Buoys would be required across the Mona Array Area and Mona Offshore Cable Corridor and would be LiDAR, wave or guard buoys. Each buoy would include a lantern suitable for use as a navigational aid.

3.6.12.3 These devices would be attached to the seabed using mooring devices such as common sinkers (small block of heavy material such as concrete and steel) or anchored by means of regular anchors. They could have one single mooring point or several points (usually up to three).

3.6.13 Transmission system

3.6.13.1 The transmission system is used to transport the electricity produced at the wind turbines to the UK National Grid. The electricity is transported from the offshore OSP's, through the offshore and onshore export cables and a number of onshore components. The transmission system is usually designed, paid for and constructed by the wind farm developer (the Applicant), but must be purchased by an Offshore Transmission Operator (OFTO) after the wind farm is constructed in a transaction overseen by the Office of Gas and Electricity Markets (Ofgem).

Circuit description

3.6.13.2 A circuit is an electrical system that allows the flow of electricity from one location to another. Generally, HVAC transmission systems require conductors as part of the electrical circuit to transport the electricity. Offshore, the three conductors of one circuit are usually combined into a single cable. Onshore these three conductors are usually housed within one cable per conductor (i.e. three cables per circuit).

The Mona Offshore Cable Corridor

3.6.13.3 The Mona Offshore Cable Corridor can be seen in Figure 3.1, and the maximum design parameters for the Mona Offshore Cable Corridor are presented in Table 3.24. Although the Mona Offshore Cable Corridor has been identified, the exact route of the offshore export cables is yet to be determined and will be based upon geophysical and geotechnical survey information. The Mona Offshore Cable Corridor may be refined following further project design and consultation and will be presented in the application for consent.

Offshore export cables

3.6.13.4 The offshore export cables are used for the transfer of electricity from the OSPs to the landfall and onwards to connect to the onshore National Grid substation. Up to four offshore export cables, with a voltage of up to 275kV will be required for the Mona Offshore Wind Project. Each offshore export cable will also house a fibre optic cable for communication. Where possible, the cables will be buried below the seabed to landfall.

3.6.13.5 The Applicant requires flexibility in type, location, depth of burial and protection measures for the offshore export cables to ensure that anticipated physical and technical constraints and changes in available technology can be accommodated within the Mona Offshore Wind Project design.

Table 3.24: Maximum design parameters for the Mona Offshore Cable Corridor and offshore export cables.

Parameter	Maximum design parameters
Number of circuits	4
Voltage (kV)	275
Cable diameter (mm)	350
Length of the Mona Offshore Cable Corridor (km)	90
Width of the Mona Offshore Cable Corridor (km)	1.5
Total length of offshore export cables (km)	360

Installation

3.6.13.6 The offshore export cable installation methodology, as well as the burial depth and any requirement for protection measures, will be defined by a detailed CBRA. The offshore export cables will be buried to a target depth of 1m with a maximum burial depth of 3m and a minimum burial depth of 0.5m. The CBRA will be undertaken post-consent and will inform cable burial depth which will be dependent on ground conditions as well as external risks. The installation techniques being considered include pre-lay plough, plough, trenching, and jetting.

3.6.13.7 The offshore export cables will require protection where the cable crosses obstacles such as exposed bedrock, pre-existing cables or pipelines that mean the cable cannot be buried. Cable protection methods being considered include rock protection, concrete mattresses, fronded mattresses and rock bags. These are described further in paragraph 3.6.9.6 to 3.6.9.9. Up to 20% of the total export cable length may require protection due to ground conditions (this excludes cable protection due to cable crossings).

3.6.13.8 The maximum design parameters for installation of up to four export cables are presented in Table 3.25. The vessel requirements for offshore export cable installation are presented in Table 3.26.

Crossings

3.6.13.9 The Mona Offshore Cable Corridor crosses a number of existing assets, primarily interconnector cables in the Irish Sea. The design of these crossings will be confirmed in agreement with the asset owners, however it is likely that a berm of rock will be placed over the existing asset for protection. The export cable will then be laid across this, at an angle as close to 90 degrees as possible. The export cable will then be covered by a second post lay berm to ensure that the export cable remains protected and in place. The parameters for these crossings are presented in Table 3.25.

Table 3.25: Maximum design parameters for export cable installation and export cable protection.

[a] Typically the cable will be buried between 0.5 to 3m. A CBRA will inform cable burial depth, dependent on ground conditions as well as external risks. This assessment will be undertaken post-consent.

Parameter	Maximum design parameters
Installation methodology	Prelay plough, plough, trenching and jetting
Target burial depth	1m. Dependent on CBRA [a]
Width of seabed affected by installation per cable (m)	20
Duration: total (months)	27
Seabed disturbance – total (m^2)	7,200,000
Height of cable protection (m)	3
Width of cable protection (m)	10
Percentage of route requiring protection (%)	20
Cable protection area (m^2)	720,000
Cable protection volume (m^3)	1,080,000
Indicative number of crossings	24
Cable/pipe crossings: total impacted area (m^2)	144,000
Cable/pipe crossings: cable protection volume (m^3)	108,000

Table 3.26: Maximum design parameters for export cables- vessel requirements.

Parameter	Maximum number of vessels on site at any one time	Maximum number of return trips per vessel type over the construction period
Cable lay and support vessels	6	40
Guard vessels	1	18
Survey vessels	2	4
Seabed preparation vessels	4	24
CTVs	2	20
Cable protection installation vessels	2	20

Offshore interconnector cables

3.6.13.10 The Mona Offshore Wind Project will require cables to connect the OSPs to each other in order to provide redundancy in the case of cable failure. The interconnector cables will have a similar design and installation process to the offshore export cables and inter-array cables. The parameters for design and installation of the interconnector cables are presented in Table 3.27, Table 3.28 and Table 3.29.

Table 3.27: Maximum design parameters for interconnector cables.

Parameter	Maximum design parameters
Number of cables	4
Total cable length (km)	50
Voltage (kV)	275

Table 3.28: Maximum design parameters for interconnector cable installation and interconnector cable protection.

[a] Typically the cable will be buried between 0.5 to 3m. A CBRA will inform cable burial depth, dependent on ground conditions as well as external risks. This assessment will be undertaken post-consent.

Parameter	Maximum design parameters
Installation methodology	Prelay plough, plough, trenching and jetting
Target burial depth	1m. Dependent on CBRA [a]
Width of seabed affected by installation per cable (m)	20
Duration: total (months)	30
Seabed disturbance – total (m^2)	1,000,000
Height of cable protection (m)	3
Width of cable protection (m)	10
Percentage of route requiring protection (%)	20
Cable protection area (m^2)	100,000
Cable protection volume (m^3)	150,000
Indicative number of crossings	10
Cable/pipe crossings: total impacted area (m^2)	5,000
Cable/pipe crossings: cable protection volume (m^3)	30,000

Table 3.29: Maximum design parameters for interconnector cables - vessel requirements.

Parameter	Maximum number of vessels on site at any one time	Maximum number of return trips per vessel type over the construction period
Cable lay and support vessels	4	8
Survey vessels	1	2
Seabed preparation vessels	4	4
CTVs	1	365
Cable protection installation vessels	2	2

3.6.14 Intertidal area

Overview

3.6.14.1 The Mona intertidal area is the area within the Mona Onshore Cable Corridor, between MHWS and Mean Low Water Springs (MLWS). Figure 3.13 presents the Mona Onshore Cable Corridor, including the Mona intertidal area.

3.6.14.2 The offshore export cables will make landfall in Llanddulas, North Wales. The offshore export cables will be brought through the intertidal area to a location where they can be connected to the onshore export cables. The offshore export cables are connected to the onshore export cables at the onshore TJBs (see section 3.7.2.1).

3.6.14.3 Methods being considered for installation of the export cable in the intertidal area include open cut trenching and trenchless techniques. The technical feasibility of these methods will be confirmed by geotechnical investigations. The indicative locations of where these techniques maybe used in the intertidal area is shown on Figure 3.15.

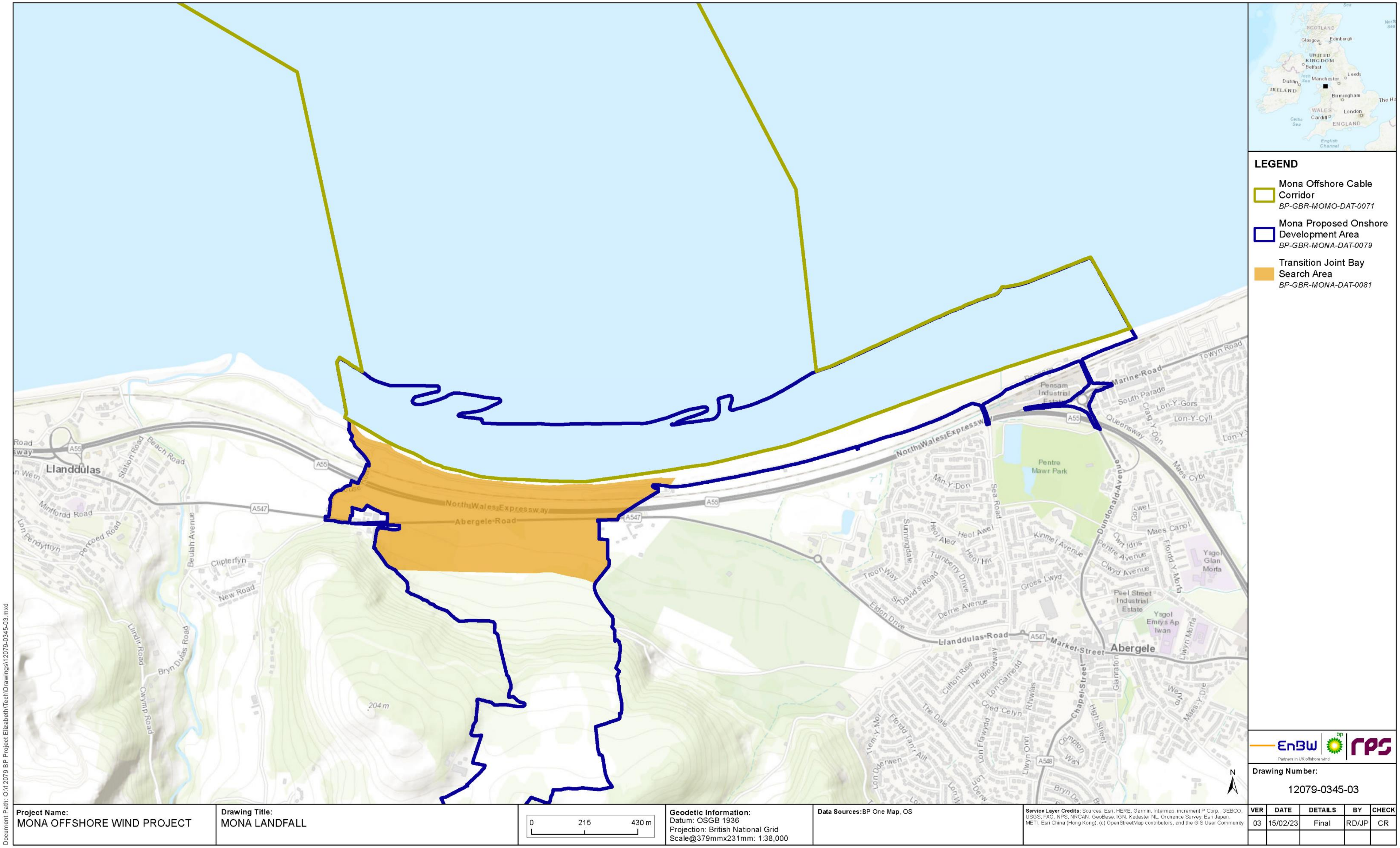

Figure 3.13: Mona Landfall.

Open cut trenching

3.6.14.4 Open cut trenching involves creating a trench within which the cable is laid and the trench or ploughed area is backfilled. It may be carried out on the beach using ploughs, excavators, rock cutters or jetting tools which may be self-powered or can be pulled from the offshore installation vessel. The installation tools would be pulled over a positioned export cable to simultaneously open the trench, place the cable in the trench, and bury the cable. Alternatively, the installation tool may open the trench as a separate activity before the cable is lowered into the trench and buried. Figure 3.14 shows an example of this type of installation tool.

3.6.14.5 If this technique were required, open cut trenching would be undertaken for the extent of the intertidal area, from the HDD exit point.

Figure 3.14: Example of shallow water trenching vehicle, with support vessels achieving subsea cable burial (photo courtesy of JDN contracting).

3.6.14.6 The maximum design parameters for installation of the export cable using open cut techniques in the Mona intertidal area are presented in Table 3.30

Table 3.30: Maximum design parameters for landfall open cut trenching at the landfall.

Parameter	Maximum design parameters
Number of trenches	4
Trench width at the top (m)	3
Trench width at the bottom (m)	1
Trench length (km)	1.5
Trench depth (m)	3
Total area of four trenches (m^2)	18,000
Volume of excavated material (m^3)	54,000
Working areas (width either side of trench) (m)	25
Total area disturbed (m^2)	306,000

Trenchless techniques

3.6.14.7 Trenchless techniques, such as Horizontal Directional Drilling (HDD) or thrust bore will be used to cross the intertidal area, under the sea defences, coastal path, railway, A55 and A547 to reduce disturbance to the receiving environment and infrastructure by drilling a borehole underneath the surface of the intertidal area. A small pilot borehole is initially used before this is enlarged by a larger cutting tool, then the duct is placed inside the borehole and the export cable is pulled through. The HDD exit position may be in the intertidal zone or below MLWS.

3.6.14.8 Temporary exit pits for the trenchless techniques will be required. The exit point may be either located within the intertidal zone between MLWS and MHWS; or below MLWS. Where the location is above MLWS, the exit pits will be excavated or dredged to the required depth, and side-cast material for backfilling will be stored adjacent to the exit pit. For this option it would be required to install cofferdams temporarily to reduce water intrusion. The cofferdams will consist of sheet metal piles of typically 25mm thickness installed by vibro-piling from land-based construction plant during daylight hours.

3.6.14.9 The plant required to excavate and reinstate the exit pits and install and remove the cofferdams would access the intertidal area daily, either by beach-landing craft or by beach ramp at Pensarn (subject to weight restrictions) over a period of up to two weeks for each cofferdam potentially over two seasons.

3.6.14.10 The maximum design parameters for trenchless techniques at the landfall are presented in Table 3.31 and are based on a maximum of four circuits.

Table 3.31: Maximum design parameters for trenchless techniques at the landfall.

Parameter	Maximum design parameters
Type of Trenchless Technique	HDD or thrust bore
Number of HDD cable ducts	4
Diameter of cable ducts (m)	1

Parameter	Maximum design parameters
Length of cable ducts (km)	2
HDD bore diameter (m)	1.4
HDD burial depth maximum landward of MHWS (m)	30
HDD burial depth minimum landward of MHWS (m)	5
HDD exit pits number	4
HDD burial depth maximum between MHWS and MLWS (m)	25
Length of cable ducts between MHWS and MLWS (km)	1.5
HDD working compound (m)	100 x 150
Offshore Corridor width* (m) *corridor width tapers from mean low water to TJB (100m)	200

Programme

3.6.14.11 The trenchless techniques to the top of the beach will take nine months to complete; the open cut trenching between MHWS and MLWS will take up to 33 months.

3.6.14.12 It is anticipated that construction working hours for the landfall construction will be 07.00 to 19.00 Monday to Saturday. Working hours are not proposed for Sundays or bank holidays. Extended working hours may be required to maintain programme progress; some activities may require limited 24 hour works, such as HDD works.

3.6.14.13 Refer to Section 3.8 for further detail as to how the construction programme for the landfall fits into the wider project programme.

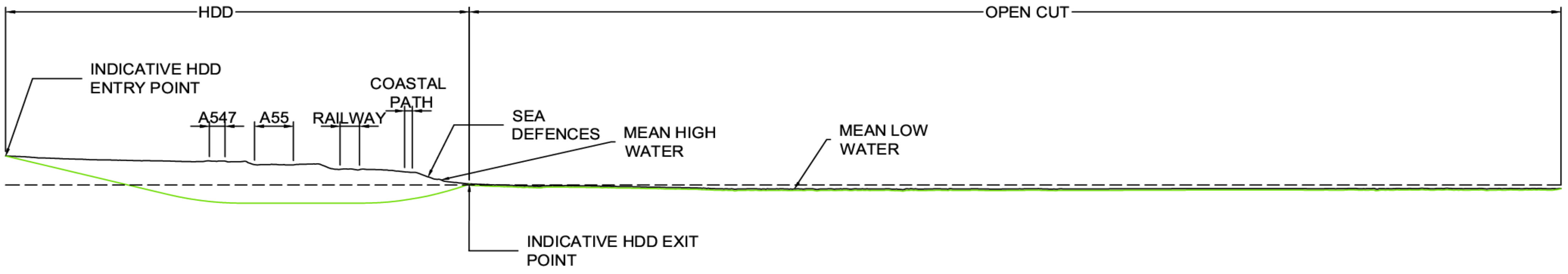

Figure 3.15: Indicative cross section at landfall.

3.7 Onshore infrastructure

3.7.1 Overview

3.7.1.1 As set out in paragraph 3.3.1.1, the permanent onshore infrastructure for the Mona Offshore Wind Project includes the onshore export cable(s), the Mona Onshore Substation and the Mona 400kV Grid Connection Cable(s) (see Figure 3.16).

3.7.1.2 The onshore export cable(s) will provide a cable connection between the landfall site and the Mona Onshore Substation.

3.7.1.3 The Mona Onshore Substation will transform the power supplied from the offshore wind farm to 400kV, as required to allow a connection to the National Grid. The connection will be achieved by the Mona 400kV Grid Connection Cable(s) and will connect the Mona Onshore Substation to the existing National Grid substation at Bodelwyddan.

3.7.1.4 The permanent onshore infrastructure will be located within the Mona Proposed Onshore Development Area together with mitigation areas and temporary construction facilities (such as access roads and construction compounds).

3.7.1.5 Potential locations for the temporary construction facilities are shown on Figure 3.19. The option locations for the Mona Onshore Substation options are shown on Figure 3.20 and both options are assessed in the PEIR. Only one of the options will be taken forward to the DCO application.

3.7.1.6 The location of the Mona Onshore Substation options and the other permanent infrastructure has been informed by a site selection and route refinement process which is detailed in volume 1, chapter 4: Site selection and consideration of alternatives of the PEIR. This process has considered a wide range of human, biological and physical constraints as well as technical and commercial factors. The process of site selection and refinement remains ongoing, and the selected locations for the Mona Onshore Substation, Onshore Cable Corridor and 400kV Grid Connection Cable Corridor will be presented in the application for consent.

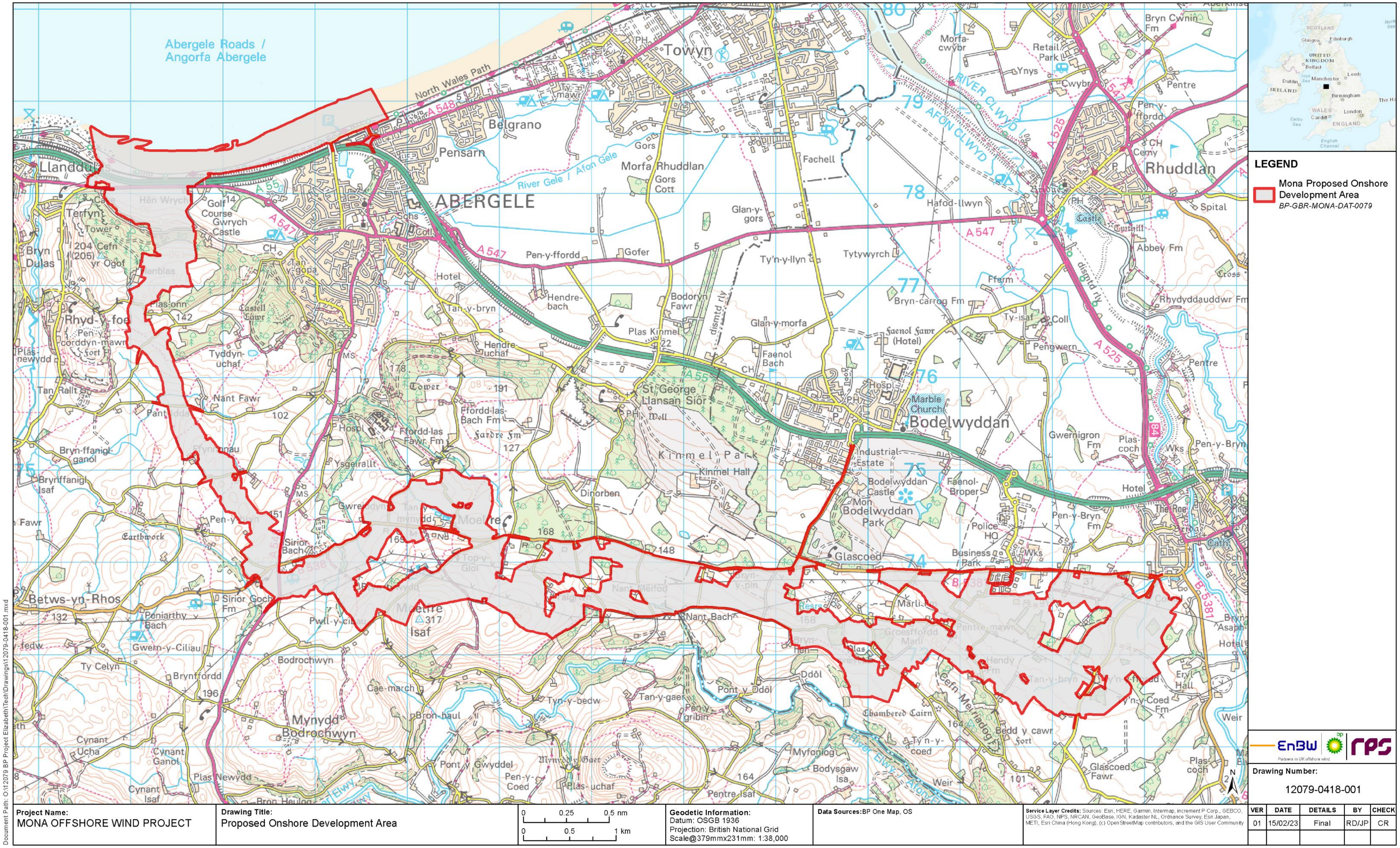

Figure 3.16: Mona Proposed Onshore Development Area.

3.7.2 Onshore export cables

3.7.2.1 The offshore export cables will connect to the onshore export cables at the Transition Joint Bays (TJBs). The search area for the TJBs is shown on Figure 3.13. Table 3.32 presents the maximum design parameters for TJBs and landfall works.

3.7.2.2 The onshore TJBs will be located above MHWS in farmland to the south of the A547.

3.7.2.3 One TJB is required per export cable circuit to ensure that the jointing can take place in a suitable environment, and to protect the joints. Once the joint is completed the TJBs are covered and the land above reinstated. The maximum design parameters for the TJBs and intertidal area are presented in Table 3.32.

Table 3.32: Maximum design parameters for TJBs and landfall works.

Parameter	Maximum design parameters
Number of TJBs	4
TJB depth (m)	4
Area of TJBs (m^2)	1,200
TJB construction compound (m)	150 x 100

Cable route design

3.7.2.4 The onshore export cables will transfer the electricity onwards to the onshore substation. The onshore export cables will be buried for their entire length. Overhead lines are not proposed for the Mona Offshore Wind Project.

3.7.2.5 The operating voltage of the cables would be selected prior to construction but is likely to be either 220kV or 275kV. The number of cable circuits required will depend on the voltage selected (with higher voltages requiring fewer cable circuits). A 220kV design is likely to require up to four cable circuits, while a 275kV design is likely to require fewer cable circuits.

3.7.2.6 A maximum of four circuits has been assumed as the maximum design parameter for environmental assessment. Each cable circuit will consist of three cables, giving a total of up to 12 cables laid in trefoil formation or separately. Once installed, the cables will occupy a corridor approximately 30m wide although this width may change where obstacles are encountered.

3.7.2.7 The onshore export cables will be located within the Mona Proposed Onshore Development Area. At this time, it is anticipated that the cables would route south from the landfall and pass to the west of Abergele. They would then route southeast towards the A548 and B5381 junction and then northeast in the vicinity of the B5831 before turning east towards Bodelwyddan, running south of the B5831.

3.7.2.1 There are sections of the Mona Onshore Cable Corridor where optionality for the route has been retained. Optional routes are identified north and south of Moelfre, south of the Kimnel Estate and south of Groesffordd Marli. The Mona Onshore Cable Corridor will select a single route following consultation responses on the PEIR. More details on the Mona Onshore Cable Corridor route refinement are available within volume 1, chapter 4: Site selection and consideration of alternatives of the PEIR.

3.7.2.2 The Mona Onshore Cable Corridor will be approximately 18km in length. The cables will be buried underground at a typical depth of approximately 1.8m. This target burial depth may be exceeded where the route is required to cross beneath features such as pipelines, land drains, highways or rivers. The Mona Onshore Cable Corridor will be up to 100m wide (including the temporary construction width) to allow up to four cable circuits to be installed.

3.7.2.3 The cables themselves consist of copper or aluminium conductors wrapped with various materials for insulation, protection, and sealing. Table 3.33 shows the MDS for the onshore export cables.

Table 3.33: Maximum design parameters for onshore export cables.

Note that the maximum voltage and maximum number of circuits/export cables would not occur together. The maximum number of cables relates to the 220kV design option.

Parameter	Maximum design parameters
Maximum number of circuits	4
Maximum number of export cables	12
Length of onshore export cable corridor (km)	18
Width of onshore export cable corridor - permanent (m)	30
Width of onshore export cable corridor – permanent and temporary (m)	100
Maximum voltage (kV)	275
Diameter of cable (mm)	200

3.7.2.4 In addition to the above, fibre-optic cables are likely to be required for communications and temperature sensing. This may include up to one communications and one temperature sensing fibre-optic cable per circuit.

Joint bays and link boxes

3.7.2.5 Joint bays (JBs) and link boxes (LBs) will be required along the onshore cable route. JBs are typically concrete lined pits, that provide a clean and dry environment for jointing sections of cable together. JBs will only require access in the event of a cable failure requiring replacement.

3.7.2.6 LBs are smaller pits compared to JBs, which house connections between the cable shielding, joints for fibre optic cables and other auxiliary equipment. Land above the JBs will be reinstated, an inspection cover will be provided on the surface for LBs for access during the operations and maintenance phase. The MDS for JBs and LBs is presented in Table 3.34 and Table 3.35.

Table 3.34: Maximum design parameters for JBs.

[a] Excluding JBs on either side of trenchless crossings where closer spacing may be required.

Parameter	Maximum design parameters
Number of JBs	96
Maximum distance between JBs (on one circuit) (m)	1,750
Minimum distance between JBs (on one circuit) (m[a])	750
Area of JB (m^2)	200
Depth of JB (m)	2

Table 3.35: Maximum design parameters for LBs.

[a] Excluding LBs on either side of trenchless crossings where closer spacing may be required.

Parameter	Maximum design parameters
Number of LBs	96
Maximum distance between LBs (on one circuit) (m)	1,750
Minimum distance between LBs (on one circuit) (m[a])	750
Area of LB (m^2)	6
Depth of LB (m)	1

Onshore export cable installation

Sequence of installation

3.7.2.7 Installation of the onshore export cables is likely to be undertaken in the following broad sequence:

1. Completion of any required pre-construction surveys
2. Installation of fencing within the construction areas
3. Site clearance, including vegetation clearance, where required
4. Topsoil strip and storage within the easement
5. Establish and prepare temporary haul road along onshore cable route
6. Excavate trenches for direct burial and/or ducted cable, with subsoil removed from the trench and stored on site
7. HDD or trenchless techniques will be used to install ducts defined obstructions
8. Excavation of JBs and LBs (this may also be undertaken after the ducting is laid and the cable trench is reinstated)
9. Cable laying and placement of stabilised backfill material
10. Cable jointing and fibre splicing followed by backfill of joint bays/installation of inspection covers
11. Removal of haul road
12. Replacement of subsoil and topsoil
13. Reinstatement to previous land use including field drainage
14. Removal of temporary fencing
15. Planting of any sections of replacement hedgerow.

Pre-construction surveys

3.7.2.8 These may include:

- Topographic surveys
- Ecological pre-construction work (for instance hedgerow removal or creation of mitigation badger setts) and surveys to inform any protected species mitigation licence(s) that may be required
- Ground investigations (e.g. geotechnical and ground stability surveys)
- Soil surveys
- Drainage surveys
- Pre-entry records and requirements for landowner condition records
- Pre-entry condition surveys for the minor road links and new junctions off existing highway
- Targeted archaeological excavations to confirm the findings of the EIA process.

3.7.2.9 Any targeted investigations will be undertaken in accordance with industry best practice and applicable guidelines.

Fencing

3.7.2.10 At the commencement of construction, the Mona Onshore Cable Corridor would be fenced from livestock and public access. Allowances would be made for private land access, livestock crossing and relevant ecological constraints in consultation with individual landowners. In addition, sections of cable to be installed by HDD would not require fencing in between the HDD compounds.

3.7.2.11 The type of fencing to be used will be dependent on the land use where the Mona Onshore Cable Corridor crosses it.

3.7.2.12 Fencing will be installed as part of the early construction works and would typically consist of:

- Post and rope for arable land
- Post and rail for horse fields
- Post mesh and wire/barbed wire for cattle and sheep.

3.7.2.13 Fencing details will be agreed as part of the post-consent process through the discharge of DCO requirements.

Cable route installation

3.7.2.14 Open trenching will be used to construct the majority of the Mona Onshore Cable Corridor. Where this is the case, the construction corridor will include up to four cable trenches and a temporary construction haul road. The majority of topsoil and subsoil excavated from the trenches will be stored in separate linear stockpiles adjacent to the trenches within the construction corridor. In some cases, additional soil storage areas may be required, and these areas will be located within the Mona Proposed Onshore Development Area.

3.7.2.15 The dimensions of the onshore export cable trenches are presented in Table 3.36.

Table 3.36: Maximum design parameters for onshore export cable installation.

Parameter	Maximum design parameters
Trench width at base (m)	1.5
Trench width at surface (m)	2.5
Corridor width (temporary and permanent) (m)	100
Target depth of trench(m)	1.8
Trench depth of stabilised backfill (m)	0.6
Total Installation duration (months)	33

3.7.2.16 An indicative cross section for the construction corridor is shown in Figure 3.17 and Figure 3.18.

3.7.2.17 The typical corridor width will be reduced when crossing important hedgerows (as defined by the Hedgerows Regulations 1997) or where other constraints create a ‘pinch point’ by applying a range of special engineering techniques that could include:

- Using lower thermal resistivity backfill in the cable trench
- Removing the spoil to a storage area further up or down the onshore cable route (away from the reduced working width location), thereby negating the need to store spoil adjacent to the trenches.

3.7.2.18 As a consequence of these reduced cable route working widths, the typical corridor width will be widened at locations where spoil (from the reduced working width sections) is moved to. The cable route working width may also be widened if a primary HDD technique is utilised for crossings (see section on Crossings and trenchless techniques).

3.7.2.19 The trenches will be excavated using a mechanical excavator or trenchers, and the ducts will be installed into the open trench. The ducts will be buried in a layer of stabilised backfill material that ensures a consistent structural and thermal environment for the onshore export cables. All material excavated from the trenches will be stored on site.

3.7.2.20 Hard protective tiles, protective tape and marker tape will be installed in the trenches above the cables to indicate the presence of the cable to ensure the cable is not damaged by any third party. Once the onshore export cables are installed the trenches would be backfilled with the excavated material; first with the subsoil, followed by the topsoil, and the land reinstated back to its previous use.

3.7.2.21 Once the ducts are installed and the trenches backfilled, the cables will then be pulled through the ducts from the JBs.

3.7.2.22 Dewatering of trenches may be required. This will require establishment of a pump; a welfare unit and generator may also be required at dewatering locations. In the event that trenches need dewatering, water from the dewatering activities will be discharged in agreement with Natural Resources Wales (NRW) to a local drainage ditch or watercourse and/or spread over ground.

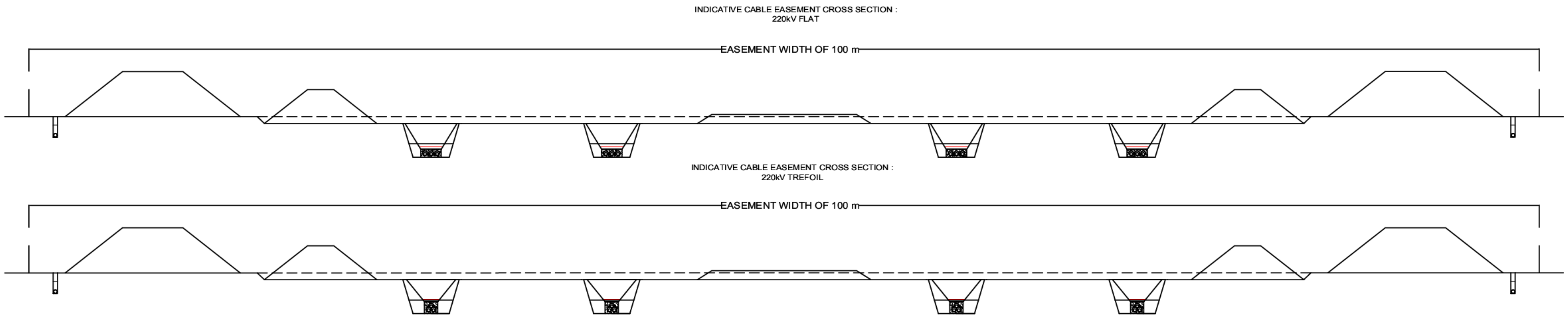

Figure 3.17: Indicative cross section of the onshore export cable.

Figure 3.18: Example of an onshore export cable trench.

Crossings and trenchless techniques

3.7.2.23 The route of the onshore export cables and Mona 400kV Grid Connection Cable(s) will cross existing infrastructure and obstacles such as roads, railways and watercourses. The Mona Offshore Wind Project will aim to undertake all major crossings, such as major roads, river and rail crossings using HDD or other trenchless technologies, such as auger boring or micro-tunnelling.

3.7.2.24 HDD involves drilling underneath the obstacle. A small pilot borehole is generally used before this is enlarged by a larger cutting tool. Bentonite is pumped to the drilling head during the drilling process to stabilise the hole and ensure that it does not collapse. The duct is placed inside the borehole and the export cable is pulled through. These ducts are either constructed offsite or will be constructed onsite within the Mona Proposed Onshore Development Area, then pulled though the drilled hole either by the HDD rig or by separate winches.

3.7.2.25 At this stage, locations for trenchless techniques remain under consideration, but are likely to include the following:

- The onshore export cable route from the landfall site beneath the historic landfill, coastal footpath, sea defence, A55, A547 and railway to the onshore TJB locations
- The woodland associated with the Gwyrch Castle estate
- Major road crossings
- Areas of woodland
- Watercourse crossings, where appropriate.

3.7.2.26 For smaller less sensitive infrastructure it can be quicker and less disruptive to make the crossings using open cut techniques rather than undertaking the works required for HDD.

Watercourse crossings

3.7.2.27 In most cases, HDD will be used to pass beneath watercourses. However, trenched techniques may be used, where appropriate, such as for minor ditches or smaller watercourses that are frequently dry. Where this is the case, measures will be put in place to protect water quality and flow (where relevant).

Hedgerow crossings

3.7.2.28 Where hedgerows and trees occur within the area affected by the onshore cable route and/or construction accesses, they will be removed, except on sections of the route where HDD is proposed (such as beneath substantial areas of woodland). In addition, hedgerow removal may be required to allow for access and to meet visibility requirements at access points.

3.7.2.29 In each case, the width of hedge or number of trees to be removed will be limited where practicable. Further details on hedgerow removal are presented in volume 3, chapter 18: Onshore ecology of the PEIR.

Road crossings

3.7.2.30 Major road crossings are likely to be installed by HDD or other trenchless techniques. Where the cable route crosses local roads and private accesses, access to properties and settlements will be retained. Where diversions on the existing road network are readily available, temporary road closures may be undertaken.

3.7.2.31 Road closures will be phased in order to ensure that access is retained to all villages and properties. Closures affecting the same road would not be undertaken simultaneously.

Drainage management

3.7.2.32 During construction, a drainage strategy will be implemented that will control surface water runoff, including measures to prevent flooding of the working area or offsite and to ensure any runoff is treated appropriately.

3.7.2.33 It is possible that existing field drainage could be affected by the onshore export cable installation works. To manage this, the contractor will develop a field drainage strategy in consultation with the landowners affected. It may be necessary to install additional field drainage on either side of the cable corridor to ensure the existing drainage of the land is maintained during and after construction.

3.7.2.34 The installation of additional field drainage would typically use tracked machinery (e.g. small trenching machines).

Temporary construction compounds

3.7.2.35 Construction compounds will be established within the Mona Proposed Onshore Development Area early in the construction programme. Figure 3.19 shows the search areas where the temporary construction compounds may be located.

3.7.2.36 A main construction compound will be required within the Mona Proposed Onshore Development Area, to support the construction of the onshore export cables. This will operate as a central base for the onshore construction works and will house the central offices, welfare facilities, and stores, as well as acting as a staging post and secure storage for equipment and component deliveries.

3.7.2.37 Additional construction compounds of various sizes will be required for laydown and storage of materials and plant, as well as space for small temporary offices, welfare facilities, security, parking and wheel washing facilities. These compounds will be smaller than the main construction compound and will be located within the Mona Proposed Onshore Development Area, taking into account environmental constraints.

3.7.2.38 Storage areas may also be required at various locations within the Mona Proposed Onshore Development Area. These will operate as areas where some limited additional storage may be required in addition to the temporary land within the 100m temporary corridor.

3.7.2.39 Construction compounds will also be required where trenchless techniques, such as HDD are used. Major HDD operations will require an HDD compound to contain the drilling rig, equipment and the drill entry and exit pit. These compounds will be located within the Mona Proposed Onshore Development Area. However, most compounds for HDD crossings will be located either side of the haul road and within the 100m temporary construction corridor.

3.7.2.40 Construction compounds will be prepared by removing and storing soils and then constructing hardstanding areas using crushed stone or other suitable material. Security and fencing will be provided at work sites on a 24 hour basis. Security lighting will be required at the compounds. Task lighting may also be required during working hours in the winter months.

3.7.2.41 The maximum design parameters for compounds to support construction of the onshore export cable route are presented in Table 3.37.

Table 3.37: Maximum design parameters for construction compounds.

Parameter	Maximum design parameters
Primary compound size (m^2)	22,500
Primary construction compound dimensions (length and width) (m)	150 x 150
Number of primary compounds	2
Secondary compound size (m^2)	15,000
Secondary construction compound dimensions (length and width) (m)	150 x 100
Number of secondary compounds	10
Number of HDD locations	72
Primary HDD compounds (length and width) (m)	150 x 100
Secondary HDD compounds (length and width) (m)	30 x 20

Construction access points

3.7.2.42 Access points will be required from the public highway to the Mona Onshore Cable Corridor and construction compounds. Temporary access points off the highway will be installed to facilitate vehicle access from the road and into the Mona Onshore Cable Corridor during construction. The access points will be constructed in line with the local authorities' requirements.

3.7.2.43 To provide access to the Mona Onshore Cable Corridor and limit damage to the agricultural land, a temporary haul road will be installed. The haul road will provide vehicle access along the Mona Onshore Cable Corridor off the public highway and will be used where needed throughout the installation of the onshore export cables and Mona 400kV Grid Connection Cable. The haul road will be 6m wide (excluding passing places).

3.7.2.44 The haul road will be made up of permeable gravel aggregate (on average 0.4m in depth) with a geotextile or other type of protective matting, or plastic or metal plates or grating.

Programme

3.7.2.45 The installation of the onshore export cables is expected to take up to 33 months in total (including site preparation activities and reinstatement). Construction may be carried out by multiple teams at more than one location along the Mona Onshore Cable Corridor at the same time.

3.7.2.46 It is anticipated that construction working hours for the onshore cable construction will be 07.00 to 19.00 Monday to Saturday. Working hours are not proposed for Sundays or bank holidays. Extended working hours may be required to maintain programme progress; some activities may require limited 24 hour works, such as the operation of dewatering pumps.

3.7.2.47 It is anticipated that some primary HDD works may require 24 hour working depending on the nature and scale of the crossing.

3.7.2.48 Refer to Section 3.8 for further detail as to how the construction programme for the onshore export cables fits into the wider project programme.

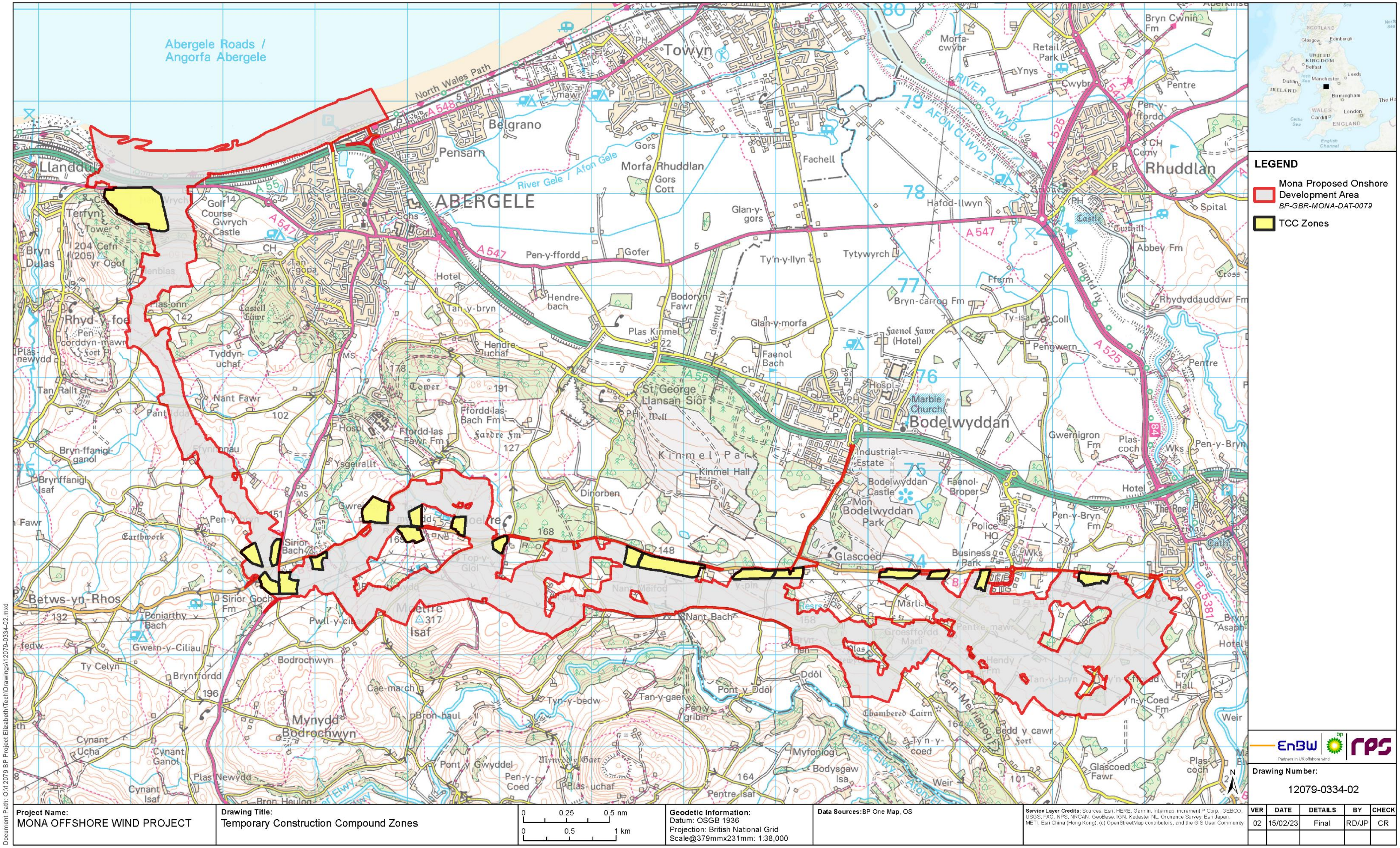

Figure 3.19: Temporary construction compound zones.

Restoration

3.7.2.49 Once the cable installation work is completed and commissioned, the haul road will be removed and the ground reinstated using stored subsoil and topsoil. All temporary construction compounds and temporary fencing will be removed, field drainage and/or irrigation will be reinstated and the land will be restored to its original condition. Where practicable, consideration will be given to early restoration of sections of the Mona Onshore Cable Corridor.

3.7.2.50 Hedgerows will be replanted using locally sourced native species, where practicable. Suitably qualified and experienced contractors will be used to undertake the reinstatement, which will be based on restoring the hedge to match the remaining hedgerow at each location. Where appropriate, some enhancement (such as planting of additional suitable species) may be undertaken.

3.7.3 Onshore substation

Location

3.7.3.1 The Mona Offshore Wind Project will connect to the national grid at the Bodelwyddan 400kV substation, located south of Rhyl, North Wales. Two locations are proposed for consideration within the PEIR – Land Substation (LSS) Option 2 which is immediately south of the Bodelwyddan 400kV substation and the Bodelwyddan to Pentir 400kV overhead lines – and LSS Option 7 which is east of the Bodelwyddan 400kV substation, near to Pen-rhew and southeast of St. Asaph town. The site selection methodology for the onshore substation is described in volume 1, chapter 4: Site selection and consideration of alternatives of the PEIR. The potential sites under consideration for the onshore substation are shown in Figure 3.20.

Design

3.7.3.2 The onshore substation will contain the electrical components for transforming the power supplied from the offshore wind farm to 400kV and to adjust the power quality and power factor, as required to meet the UK Grid Code for supply to the national grid. The onshore substation will also house the auxiliary equipment and facilities for operating, maintaining and controlling the onshore substation. The onshore substation compound would contain electrical equipment including power transformers, switchgear, reactive compensation equipment, harmonic filters, cables, lightning protection masts, control buildings, communication masts, backup generators, fencing and other associated equipment, structures or buildings. The onshore substation will have an optimised layout, with the majority of equipment contained within buildings.

3.7.3.3 The main equipment will either be housed within a single or multiple buildings, in an open space or a combination of buildings and open space. There may also be some smaller buildings required to house components such as smaller equipment and control rooms. The maximum design parameters are presented in Table 3.38.

3.7.3.4 The onshore substation building substructures are likely to be composed of steel frame and cladding materials. The structural steelwork will be fabricated and prepared off site and delivered to site for construction.

3.7.3.5 A Hydrology, Ecology and Landscape Management Plan (HELMP) will be prepared for the onshore substation site that will set out the mitigation measures for screening, ecological habitats and the management of surface water runoff. This will be submitted with the application for consent and secured as a requirement of the DCO.

3.7.3.6 The plan will include sustainable drainage measures, designed in line with The Hierarchy of Drainage set out in the National Planning Practice Guidance.

Table 3.38: Maximum design parameters for the onshore substation.

Parameter	Maximum design parameters
Substation footprint (m^2)	125,000
Impermeable footprint (m^2)	57,000
Maximum main building height (m)	20
Main building - lightning protection height (m)	30
Duration of construction and installation (months)	33
Duration of testing and commissioning (months)	10
Maximum number of main buildings	4
Maximum length of main building (m)	140
Maximum width of main building (m)	80
Width of permanent access road (m)	8
Length of permanent access road (m)	1,200

Construction

3.7.3.7 A construction compound will be required at the Mona Onshore Substation. The compound will be located within the Mona Proposed Onshore Development Area and will provide offices, welfare facilities, storage of plant and equipment and parking for construction staff.

3.7.3.8 It is anticipated that construction access to the onshore substation site will use the proposed permanent access route, albeit that during construction, a temporary surface may be used. This access route will need to be installed early in the construction process.

Pre-Construction Activities

3.7.3.9 Prior to the commencement of the onshore substation works, a number of pre-construction surveys and studies will be undertaken to inform the design teams when developing the final design, including:

- Archaeological pre-construction work
- Ecological pre-construction surveys
- Geotechnical investigations
- Drainage studies.

Landscaping and screening

3.7.3.10 The onshore substation sites both benefit from some substantial existing hedgerows and woodland blocks within the local area. However, the Applicant has committed to additional planting and landscape bunding to further screen the selected onshore substation. The search area for this proposed additional planting is provided in Figure 3.20.

3.7.3.11 The mitigation planting will be designed to comprise a mix of faster growing 'nurse' species and slower growing 'core' species. The core species will comprise a mix of preferred native, canopy species that will outlive the nurse species and characterise the woodland structure over the longer term.

3.7.3.12 In locations where it is possible to achieve advanced planting, this will be undertaken to allow growth prior to completion of construction and commencement of operation. These landscape measures will be set out in the HELMP that will be submitted with the application for consent and secured as a requirement of the DCO.

Onshore substation construction access haul road

3.7.3.13 It is anticipated that construction access to the onshore substation site will use the proposed permanent access route, albeit that during construction, a temporary surface may be used. This access route will need to be installed early in the construction process. The proposed access road search area is shown on Figure 3.20.

Grading and earthworks

3.7.3.14 To install the onshore substation working platforms some 'cut and fill' may be required (i.e. excavated material may be used to create a level site for substation construction after foundation installation). The extent of cut and fill required will be determined as the design progresses.

3.7.3.15 The location for the onshore substation is agricultural land.

3.7.3.16 The entire area will be stripped of all organic matter and loose rocks. Any waste material encountered would be removed as required by the environmental and geotechnical investigations. Once the surface has been cleared, the grading operation will begin.

3.7.3.17 If it were to prove impossible or impractical to balance the earthwork quantities, it would be necessary to either export excess soil or import suitable fill. Any soil exported would be disposed of at a licensed disposal site. Excavations of foundations and trenches would commence following the completion of grading.

Surface water drainage

3.7.3.18 Impermeable areas, for instance the control and ancillary buildings within the site, would require permanent surface drainage. Discharges would be routed to a suitable watercourse or soakaway in the absence of a local authority sewer (dependant on ground permeability).

3.7.3.19 Surface water drainage requirements would be dictated by the final drainage study and would be designed to meet the requirements of the local flood authority with runoff limited where feasible, through the use of infiltration techniques which can be accommodated within the area of development.

3.7.3.20 An indicative Onshore Substation SuDS basin area of search is illustrated on Figure 3.21. The full specification for the SuDS basin and drainage strategy would be addressed as part of the design process pre-application and finalised in detailed design post-consent. The drainage strategy will be reported in the HELMP that will be submitted with the application for consent and secured as a requirement of the DCO.

3.7.3.21 Outside of the impermeable areas the site finishes would consist of stone chippings over an appropriate thickness of sub-base to provide suitable surface for plant maintenance and permeability.

Foul drainage

3.7.3.22 Foul drainage would be collected in either of the following ways:

- Mains connection discharge to a local authority sewer system, if available; or
- Septic tank located within the onshore substation location boundary.

3.7.3.23 The preferred method for controlling foul waste will be determined during detailed design and will depend on the availability and cost of a mains connection and the number of visiting hours staff would attend site.

3.7.3.24 During construction, a drainage strategy will be implemented that will control surface water runoff, including measures to prevent flooding of the working area or offsite and to ensure any runoff is treated appropriately.

Lighting

3.7.3.25 As a maximum, design scenario, it has been assumed that some periods of 24 hour construction may be required, for which task related flood lighting may be necessary. Details of construction lighting will be set out in the Code of Construction Practice (CoCP) that will accompany the application for development consent.

3.7.3.26 Operational lighting requirements at the onshore substation site may entail:

- Security lighting around perimeter fence of compound, to allow CCTV coverage
- Car park lighting – as per standard car park lighting, possibly motion sensitive
- Repair/maintenance – task related flood lighting may be necessary

3.7.3.27 No additional lighting is proposed along the B5381 Glascoed Road or the operational access road or along the additional access roads within the substation site. An operational lighting strategy will be secured as a requirement of the DCO.

Electrical connection

3.7.3.28 The electrical equipment will then be installed and tested before being connected to the offshore wind farm and the Bodelwyddan National Grid substation. Once the construction of the onshore substation is complete the site will be secured and the supporting infrastructure finalised in readiness for the operations and maintenance phase. The temporary area will be reinstated once construction is complete.

3.7.3.29 The maximum design parameters for the substation construction compound are presented in Table 3.39.

Table 3.39: Maximum design parameters for substation construction compound.

Parameter	Maximum design parameters
Onshore substation compound size (m^2)	250,000

Programme

3.7.3.30 Substation construction is expected to take up to 33 months in total (including site preparation activities and reinstatement). In addition, a period of approximately 10 months is anticipated for substation testing and commissioning.

3.7.3.31 It is anticipated that construction working hours for the substation construction will be 07.00 to 19.00 Monday to Saturday. Working hours are not proposed for Sundays or bank holidays. Extended working hours may be required to maintain programme progress; some activities may require limited 24 hour works, such as HDD works or concrete pours.

3.7.3.32 Refer to Section 3.8 Construction programme for further detail as to how the construction programme for the onshore substation fits into the wider project programme.

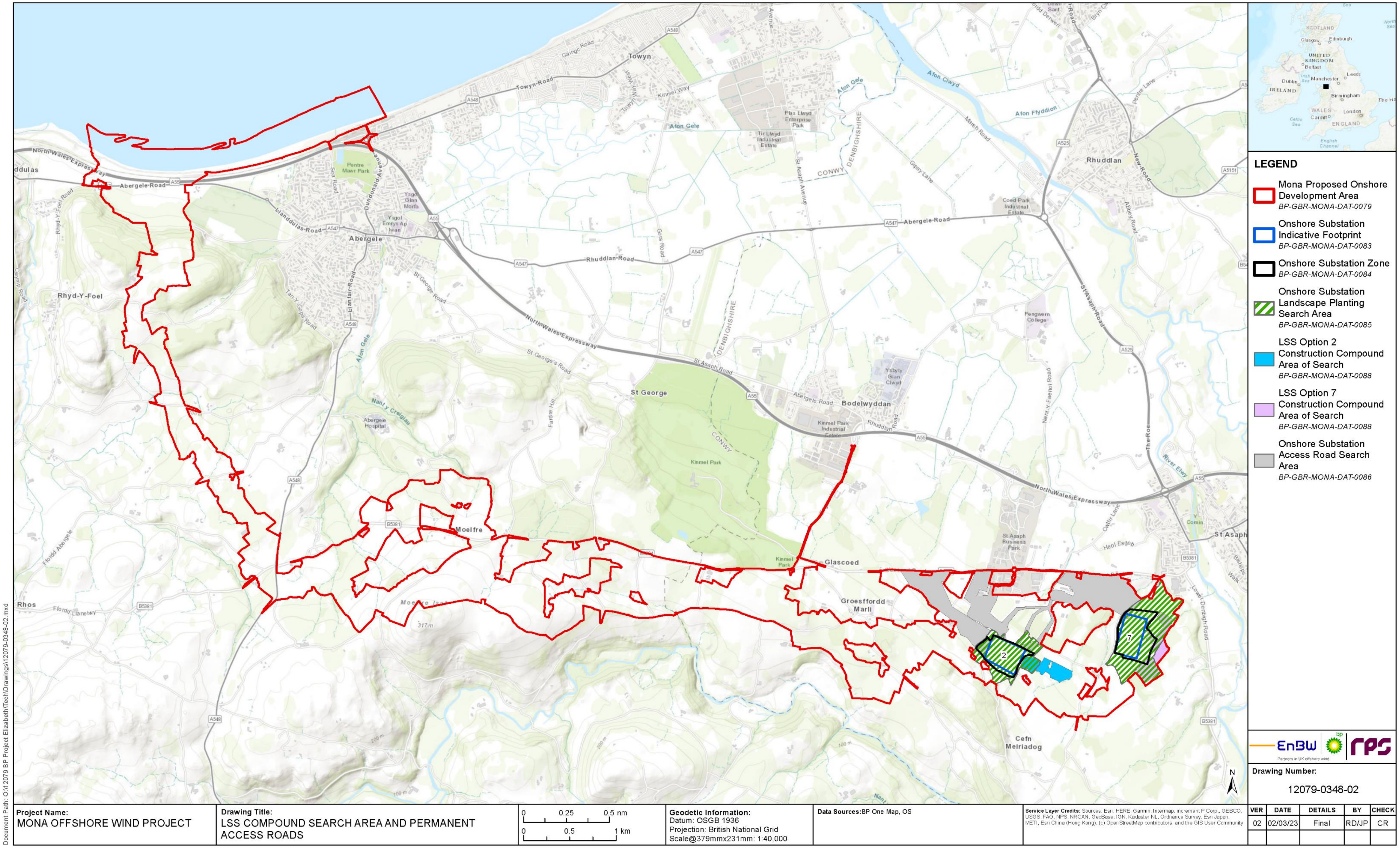

Figure 3.20: Mona Onshore Substation option locations.

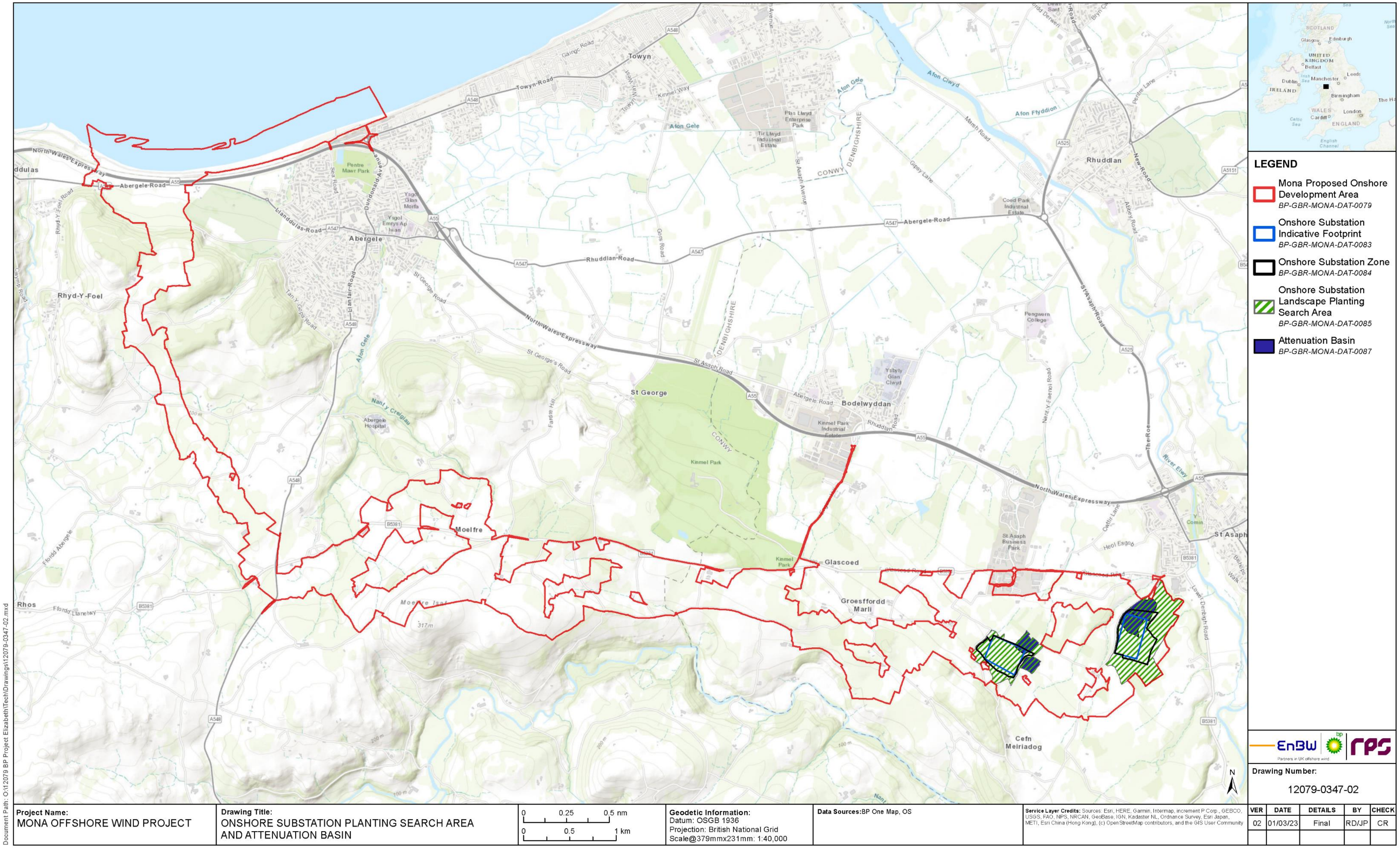

Figure 3.21: Indicative location attenuation basin.

Mona 400kV Grid Connection cable

3.7.3.33 A further section of buried onshore export cabling is required to connect the Mona Onshore Substation with the existing National Grid substation at Bodelwyddan. This is referred to as the 'Mona 400kV Gid Connection Cable' and will be located within the Mona Proposed Onshore Development Area

3.7.3.34 This section of cabling will be similar in design to the onshore export cabling, and will have a maximum of two circuits, with a total of six export cables, installed within a permanent corridor. The parameters of this section of the onshore cable route are presented in Table 3.40. An indicative cross section of the 400kV grid connection export cable trench is shown on Figure 3.22

Table 3.40: MDS for the 400kv grid connection export cable.

Parameter	Maximum design parameters
Width of corridor (temporary and permanent) (m)	60
Number of cables	6
Maximum number of cable trenches	2
Cable route length (km)	3
Voltage (kV)	400
Trench width at surface (m)	2.5
Trench width at base (m)	1.5
Trench depth (m)	1.8
Number of HDD locations	12
Number of JBs	10
Minimum distance between JBs (m)	500
Number of LBs	10
Minimum distance between LBs (mm)	500

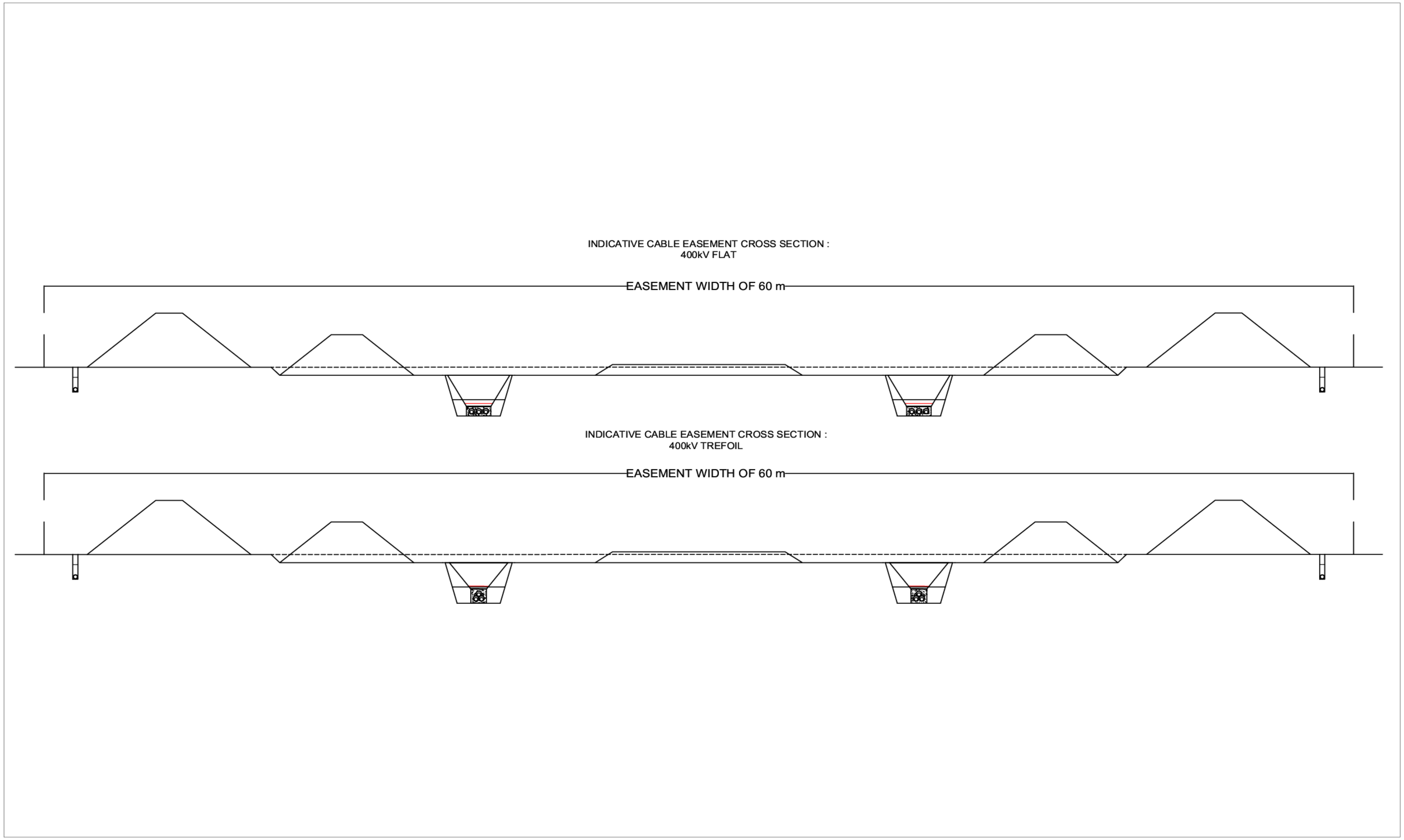

Figure 3.22: Indicative cross section of the 400kV grid connection export cable trench.

3.7.3.35 There are two proposed ‘Mona 400kV Grid Connection Cable’ routes; one associated with each onshore substation option (LSS Option 2 or LSS Option 7). The Mona 400kV Grid Connection Cable will select a single route following consultation responses on the Preliminary Environmental Information Report to determine a preferred onshore substation location. More details on the Mona onshore substation location refinement are available within volume 1, chapter 4: Site selection and consideration of alternatives of the PEIR.

Construction

3.7.3.36 Cable installation for the Mona 400kV Grid Connection Cable will use the same techniques as described for the Mona Onshore Cable Corridor above (see Section 3.7.2).

3.7.4 Construction environmental management

3.7.4.1 The onshore elements of the Mona Offshore Wind Project will be constructed in an environmentally sensitive manner. They will meet the requirements of all relevant legislation, codes of practice and standards as identified in the topic chapters of this PEIR and will limit the adverse effects on the local community and environment as far as reasonably practicable.

Code of Construction Practice

3.7.4.2 Construction will be undertaken in accordance with a CoCP. The CoCP will set out the key management measures that the Applicant will require its contractors to adopt and implement for all relevant construction activities for the onshore elements of the Mona Offshore Wind Project. Implementation of the CoCP will be secured through the DCO requirements. The CoCP will be based on the Outline CoCP, included in the PEIR, which will be refined as part of the application for development consent. These measures have been developed based on those identified during the EIA process and set out in the topic chapters of this PEIR, and in consultation with relevant consultees. They include strategies and control measures for managing the potential environmental effects of construction and limiting disturbance from construction activities as far as reasonably practicable.

3.7.4.3 The Outline CoCP will incorporate a series of environmental management plans and strategies to manage potential construction impacts, such as plans relating to the management of soils, traffic, and waste.

Local community liaison

3.7.4.4 The Applicant will establish an approach for liaising with the local community and stakeholders during the construction process, which will build on the engagement undertaken throughout the EIA process. A project website, email address and phone number will remain in place.

3.7.4.5 A Community Liaison Plan will be developed to ensure communication with the local community is appropriate, timely and easily understood. The plan will include provision for a Community Liaison Officer, who will actively work with the local community to ensure the local community is kept up to date with progress and that any queries arising are dealt with appropriately. The plan will also include a procedure for dealing with enquiries or complaints from the public, local authorities or statutory consultees.

3.7.4.6 An agricultural liaison officer will be provided as the main point of contact for landowners to provide project updates and to resolve any queries arising during the construction phase.

Traffic

3.7.4.7 Where the onshore cable route crosses local roads and private accesses, access to properties and settlements will be maintained.

3.7.4.8 Measures will be implemented to minimise dust, mud and debris associated with the movement of construction vehicles. This will include wheel washing facilities at the construction compounds and agreed locations on the Mona Onshore Cable Corridor. These measures will be included in the Outline CoCP accompanying the application for development consent.

3.7.4.9 On completion of construction, temporary vehicle accesses will be reinstated to the original highway.

3.8 Construction programme

3.8.1.1 A high-level indicative construction programme is presented in Figure 3.23. The programme illustrates the likely duration of the major construction elements. It covers installation of the major components but does not include elements such as preliminary site preparation, and commissioning of the Mona Offshore Wind Project post-construction. Further details of where preliminary site preparation work will fit within the outline programme is discussed in sections 3.6.3 for offshore activities and 3.7.1 for onshore activities. Onshore and offshore construction is currently planned to commence in 2026.

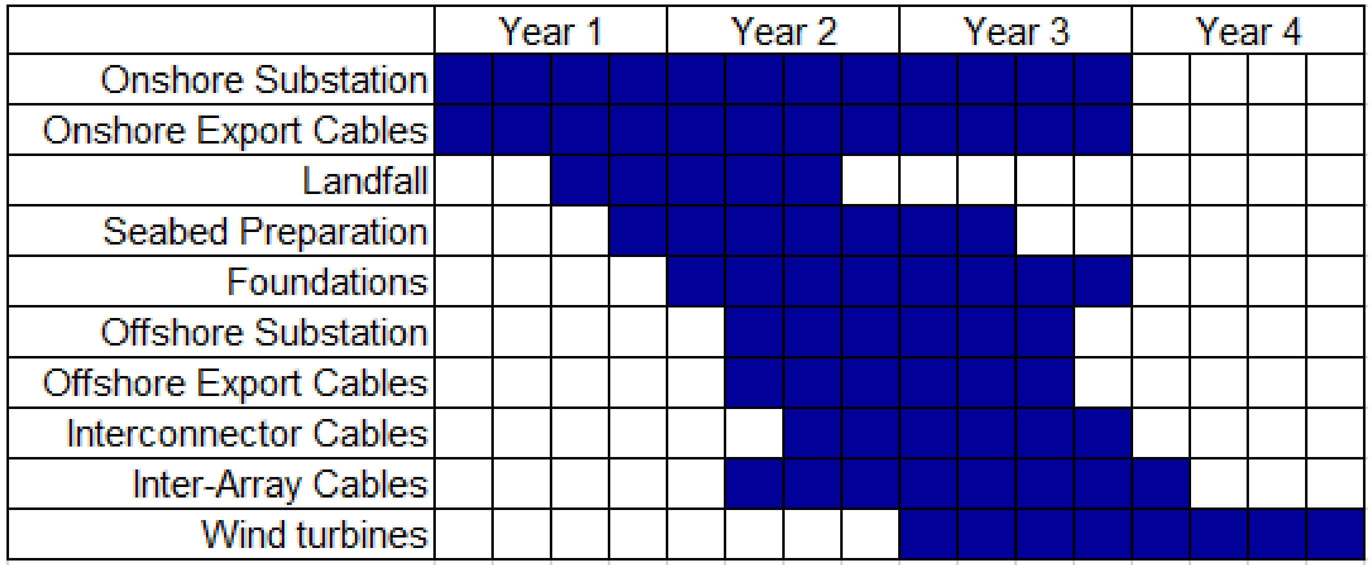

Figure 3.23: Indicative construction programme for the Mona Offshore Wind Project.

3.9 Operations and maintenance phase

3.9.1 Offshore operations and maintenance activities

3.9.1.1 The overall operations and maintenance strategy will be finalised once the technical specifications of the Mona Offshore Wind Project are known, including wind turbine type and final layout. A single port or multiple ports in north Wales and/or the north west of England could be used to support primary elements of operations and maintenance The operations and maintenance requirements for the Mona Offshore Wind Project will be set out within an outline Offshore Operations and Maintenance Plan which will be submitted alongside the application for consent.

3.9.1.2 The general operations and maintenance strategy may rely on CTVs, Service Operation Vessels (SOVs), supply vessels, cable and remedial protection vessels and helicopters for the operations and maintenance services that will be performed at the Mona Offshore Wind Project. The maximum design parameters for the operations and maintenance vessels are presented in Table 3.41. The total operations and maintenance vessel and helicopter round trips per year for the Mona Offshore Wind Project are presented in Table 3.42.

3.9.1.3 Routine inspections of inter-array, interconnector and offshore export cables will be undertaken to ensure that the cables are buried to an adequate depth and not exposed. The integrity of the cables and cable protection systems will also be checked. It is expected that on average the cables will require up to one visit per year.

Table 3.41: Maximum design parameters for offshore operations and maintenance activities.

Parameter	Maximum number of vessels on site at any one time
CTVs	6
Jack-up vessels	3
Cable repair vessels	4
Other vessels	4
Excavators or backhoe dredgers	4
Helicopters	8
Inspection drones	5

Table 3.42: Maximum design parameters for offshore operations and maintenance activities per year.

Parameter	Maximum number of return trips per vessel type per year
CTVs	2,190
Jack-up vessels	25
Cable repair vessels	16
Other vessels	104
Excavators or backhoe dredgers	16
Helicopters	730
Inspection drones	214

3.9.2 Onshore operations and maintenance activities

3.9.2.1 The onshore operations and maintenance requirements for the onshore export cables will involve infrequent on-site inspections of the onshore export cables and corrective maintenance activities. The onshore export cables will be continuously monitored remotely. Following completion of construction, access to the cable route would be from access points along the existing highway.

3.9.2.2 The onshore substation will be unmanned: the onshore infrastructure will be continuously monitored remotely, and there will be operations and maintenance staff visiting the onshore substation to undertake preventative and corrective works on a regular basis (no less than every six months).

3.9.2.3 It is not expected that the TJBs will need to be accessed during the operation of the Mona Offshore Wind Project however LBs will be provided with inspection covers to allow for access. Access will be required for an annual check and where corrective activities are required.

3.10 Security

3.10.1.1 The Mona Offshore Wind Project will be appropriately secured throughout all phases of development to ensure the safety and security of those working on the Mona Offshore Wind Project and the supply of electricity to National Grid. All above ground onshore infrastructure such as the onshore substation will be housed in secure compounds, as will any ongoing construction work. The onshore export cables are buried and will not be readily accessible from the surface.

3.10.1.2 The offshore infrastructure is by nature inaccessible due to being situated offshore.

3.11 Quality, Health, safety and environment

3.11.1.1 The Applicant has a strong focus on Health, Safety and Environment and the HSE Policy, together with processes and procedures ensure that the Applicant's wind farms are safe by design and that this is verified.

3.11.1.2 All elements of the Mona Offshore Wind Project will be risk assessed according to the relevant government guidance as well as the Applicant's internal best practice. These risk assessments will then form the basis of the methods and safety mitigations put in place across the life of the Mona Offshore Wind Project. The Applicant has a focus on employee safety and its HSE policy ensures that the Applicant's wind farms are safe by design and that the processes and procedures are adhered to. There is a clearly defined safety culture in place in order to avoid incidents and accidents. There will be constant controls to ensure that the safety measures are observed and followed and the Applicant has built a safe workplace for its employees and contractors. The

Applicant's environmental policy focuses on 'net zero', 'care for our planet' and 'improve people's lives'. They aim to make sustainability integral to thinking, decision-making and actions including engaging with stakeholders to help achieve sustainability goals. The focus on HSE is intended to ensure that everyone feels safe, in a highly controlled and safety-driven environment. This is the Applicant's first priority for the Mona Offshore Wind Project.

3.12 Waste management

3.12.1.1 Waste will be generated as a result of the Mona Offshore Wind Project, with most waste expected to be generated during the construction and decommissioning phases. In accordance with Government policy contained in NPS EN-1 (DECC, 2011), consideration will be given to the types and quantities of waste that will be generated.

3.12.1.2 Procedures for handling waste materials will be set out in the Site Waste Management Plan (SWMP) as part Outline CoCP. The SWMP will describe quantifies of likely waste type arising from the Mona Offshore Wind Project and how it will be managed (i.e. reuse, recycling, recovery or disposal). The SWMP will also describe the duty of care requirements and identify potential management facilities in the vicinity of the Mona Offshore Wind Project. The SWMP will be included in the Outline CoCP accompanying the application for development consent.

3.12.1.3 The SWMP will be updated as further detailed design information becomes available prior to construction. A Materials Management Plan in line with the Contaminated Land: Applications in Real Environments (CL:AIRE) Definition of Waste: Code of Practice will also be prepared and agreed prior to commencement of earthworks.

3.13 Decommissioning phase

3.13.1.1 Section 105 of the Energy Act (2004) requires that the Mona Offshore Wind Project is decommissioned at the end of the operations and maintenance phase. A decommissioning plan must be submitted to and approved by the Secretary of State for Business, Energy and Industrial Strategy (BEIS), a draft of which will be submitted prior to the construction of the Mona Offshore Wind Project. The decommissioning plan and programme will be updated during the Mona Offshore Wind Project lifespan to take account of changing best practice and new technologies. The scope of the decommissioning works would be determined by the relevant legislation and guidance at the time of decommissioning.

3.13.1.2 At the end of the operational lifetime of the Mona Offshore Wind Project, it is anticipated that all structures above the seabed or ground level will be completely removed where feasible and practical. The decommissioning sequence will generally be the reverse of the construction sequence and involve similar types and numbers of vessels and equipment.

3.13.2 Offshore decommissioning

Wind turbines

3.13.2.1 Wind turbines will be removed by reversing the methods used to install them, as described in section 3.6.8.

Foundations

3.13.2.2 Piled foundations would likely be cut approximately 1m below the seabed, with due consideration made of likely changes in seabed level and removed. Once the piles are cut, the foundations will be lifted and removed from the site. At this time, it is not thought to be reasonably practicable to remove entire piles from the seabed, but best practice will be employed to ensure that the sections of pile that remain in the seabed are fully buried.

3.13.2.3 Suction bucket foundations will likely be removed entirely by applying water injection into the buckets which will release the pressure holding them to the seabed. Gravity base foundations will likely be decommissioned by removing their ballast and either floating them or lifting them off the seabed.

3.13.2.4 Any scour protection will be left *in situ*.

Offshore cables

3.13.2.5 All inter-array and interconnector cables will be retrieved and disposed of onshore. In addition to this, offshore export cables will be retrieved as far as the TJBs and disposed of onshore.

3.13.2.6 At this time, it is difficult to foresee what techniques will be used if cables are to be removed during decommissioning. However, it is not unlikely that equipment similar to that which is used to install the cables could be used to reverse the burial process and expose them. Therefore, the area of seabed impacted during the removal of the cables may be the same as the area impacted during the installation of the cables.

3.13.2.7 The Energy Act 2004 requires that a decommissioning plan must be submitted to the Secretary of State for BEIS prior to the construction of the Mona Offshore Wind Project and is typically prepared post-consent. The decommissioning plan and programme will be updated during the Mona Offshore Wind Project's lifetime to take account of changes in regulations, best practice and new technologies.

Mona intertidal area

3.13.2.8 It is expected that the export cable in the intertidal area will be removed up to the TJBs. The cable ends will be cut, sealed and securely buried as a precautionary measure.

3.13.2.9 Partial removal of the export cable may be achieved by pulling the cables back out of the installation ducts. This may be preferred to recover and recycle the copper and/or aluminium and steel within them.

3.13.3 Onshore decommissioning

Onshore export cable

3.13.3.1 It is expected that the onshore export cables will be left *in situ* to minimise the environmental disturbance during wind farm decommissioning. The cable ends will be cut, sealed and securely buried as a precautionary measure.

3.13.3.2 The structures of the LBs will be removed only if it is feasible with minimal environmental disturbance or if their removal is required to return the land to its current agricultural use.

Onshore substation

3.13.3.3 The components of the onshore substation have varying life expectancies. Transformers typically have a lifetime of up to 50 years, and some components lives can be extended beyond this period. Decommissioning of the onshore substation will be reviewed in discussion with the transmission system operator and the regulator in the light of any other existing or proposed future use of the onshore substation. If complete decommissioning is required, then all of the electrical infrastructure will be removed and any waste arising disposed of in accordance with relevant regulations.

3.13.3.4 Foundations will be broken up and the site reinstated to its original condition or for an alternative use.

3.14 References

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